DELTA AS A PLACE: AGRICULTURE WHITE PAPER

Prepared for consideration by the Delta Stewardship Council

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Not reviewed by or approved by the Delta Stewardship Council

Send comments to deltaplancomment@deltacouncil.ca.gov.

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Executive Summary

For more than 150 years, agriculture has played a key role in the Sacramento–San Joaquin Delta's (Delta) settlement, economy, ecology, and contribution to the region and state. During the Gold Rush, small-scale agricultural operations began to support mining camps, and new towns. Unsuccessful miners shifted to building levees in the Delta to reclaim tidal wetlands and expand agricultural areas. Early farmers in the Delta grew field corn, sugar beets, celery, onions, asparagus, and other vegetables to supply demand from San Francisco. In 1930, land reclamation activities and levees were completed, with 313,000 acres of former wetlands put behind levees and drained for agricultural use (San Francisco Estuary Project, 1991; The Bay Institute, 1998).

Land Uses in Legal Delta

Name	% in 1984	% in 2008
Agricultural Land	80.5	73.3
Urban and Built-Up Land	6.9	10.3
Water	7.6	7.9
Other Land	5.1	8.4

Source: California Farmland Mapping and Monitoring Program, 1984 and 2008

Agriculture is currently the principal land use in the Delta. Total acreage in agricultural lands has declined from about 597,400 acres in 1984 to about 531,010 acres in 2008. This decline in acreage has resulted in a decreased percent of agricultural land in the Delta, from about 80 percent of the Delta's total land area in 1984 to about 74 percent in 2008. About 75 percent of the Delta's total land area is classified as Prime Farmland, which is defined as land with the best physical and chemical characteristics, and a reliable irrigation water supply. By comparison, only 18 percent of the entire state's agricultural land is classified as Prime Farmland.

Much of the Delta's farmland (nearly 377,000 acres) is enrolled in a state program, the California Land Conservation Act of 1965, which provides property tax reductions in exchange for maintaining land in agricultural use. This program relies on state subventions to local governments to offset local revenue loss from reduced property taxes. These state payments were significantly reduced several years ago and were halted in the 2009-2010 fiscal year because of the state's budget problems.

California is the leading agricultural producer in the nation, with 14 percent of the nation's agricultural GDP. Although the value of California's agricultural production is large, approximately $38 billion in 2009 (U.S. Department of Agriculture, 2010), this represents about 2 percent of California's estimated gross domestic product in 2009 ($1.9 trillion) (Bureau of Economic Analysis, 2010). The direct value of agriculture to California's economy exceeds the figures cited above; indirect economic activities related to agriculture also add to the state's economy in ways that are difficult to quantify.

Delta agriculture makes an important contribution to the regional and state economy. Although the exact contribution from the Delta

Top Five Crops in the Delta (2007)

By Gross Value

1. Asparagus
2. Tomatoes
3. Corn
4. Grapes
5. Alfalfa

By Acres Grown

1. Corn
2. Alfalfa
3. Grain and Hay
4. Safflower
5. Pasture

By Gross Export Value

1. Almonds
2. Dairy and Products
3. Wine
4. Table Grapes
5. Pistachios

to the state's GDP is unknown[1], the value per acre contribution is greater than other agricultural regions in the state. It has been estimated that the Central Valley region, including the Delta, contributes two thirds of the state's agricultural value (Trott, 2007). The five-county Delta region has consistently contributed (in 2007 dollars) more than $2 billion annually in agricultural gross value (Trott, 2008), and the most recent estimates indicate that the Legal Delta area contributes almost 25 percent of that (DWR, 2007c) on 20 percent of the land (Trott, 2007). Top-grossing irrigated crops include asparagus, tomatoes, corn, grapes, and alfalfa (California Department of Water Resources, 2007c). Delta agriculture contributes to at least 41 out of the 55 top-value crop exports in California. In 2008, California's agricultural exports reached an all-time high of $12.9 billion, a 16 percent increase from 2007, and nearly a third of the Delta's total agricultural value (UC Davis, 2010).

Even as the acres of farmland have declined, the value of agricultural products in the Delta has continued to increase as farmers have switched to higher value crops. In addition, "virtually every one of the crops from this diverse Delta agricultural palette, from field crops to blueberries, produces greater yields and fetches higher per unit prices than do most other growing regions of these crops in the state" (California Department of Food and Agriculture, 2008).

Each of the counties' general plans designates the Delta Primary Zone for agriculture, a designation that also allows open space, recreation, wildlife habitat, and nature preserves. The Delta counties have established minimum parcel sizes of 5 to 160 acres in the Delta Primary Zone to retain land in agricultural use, and most parcels are between 20 and 80 acres. County general plans may not fully address emerging issues such as future infrastructure threats or ecosystem restoration needs that are called for by the Delta Protection Commission, biological opinions, and state agency plans with jurisdiction in the Delta. For instance, only two of the five counties include policies in their general plans promoting recognition of and education about the Delta as a unique ecological and agricultural place. None of the counties have policies that conflict with any of the Delta Protection Commission *Land Use and Resource Management Plan* policies.

The extent and intensity of agricultural development over the past century have irreversibly changed the natural ecosystem in the Delta. These changes not only affect the species that live there, but also affect water quality, agricultural productivity, healthy commercial and sport fisheries, flood protection, and recreation. The Delta ecosystem has long been on a trajectory of change that cannot be completely reversed but can, at best, be managed.

Certain synergies between agriculture and wildlife habitat provide valuable ecological services for the Delta. Integrated management of agriculture and wildlife habitat in the Delta is becoming more common. Ecosystem compatibility with agriculture depends on intensity of cultivation and chemical application. More intensive agriculture includes orchards, vineyards, and confined animal production, which generally have less potential to support natural habitat. By contrast, less intensive agriculture, such as seasonal and nonpermanent crops (for example, small grains, field crops, truck crops, and forage crops), has generally greater potential to support natural habitat.

Examples of agricultural land use and crops that provide ecosystem benefits include alfalfa, irrigated pasture, rice, row crops, and silage.

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[1] GDP data are available for regions, including Stockton Metropolitan Statistical Area. However, no data are available for the Delta. or five-county area.

Numerous threats and future risks to the Delta will affect agriculture; some of these include urbanization, subsidence, levee failure, climate change, soil salination, and water or soil contamination. Farmers, landowners, residents, and the government have choices on how to approach these risks; and these choices can be guided by policies regarding coordinated regulations, levee improvements, freshwater releases, and adaptation and best management practices.

Agriculture is a vital part of the economy for the five-county region as well as the Legal Delta. In addition, agricultural land and associated uses provide habitat for many species. Agricultural land and its ecological functions are at risk, although agriculture itself has been responsible for many changes to the ecology of the area since it became prevalent more than 150 years ago. As development and agriculture in the Delta are evaluated, it is important to consider the benefits and risks posed by both. This paper summarizes key benefits and risks associated with agriculture in the Delta as well as policy issues to consider that may affect agriculture's continued viability.

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Contents

Section **Page**

Figures

Tables

Section 1 Introduction

In November 2009, the California Legislature enacted SBX7 1 (Sacramento-San Joaquin Delta Reform Act of 2009 [Act]), one of several bills passed at this time related to water supply reliability, ecosystem health, and the Sacramento–San Joaquin Delta (Delta). The Act, which took effect on February 3, 2010, adds Division 35 to the Water Code and creates the Delta Stewardship Council (Council) as an independent agency of the state. The Act charges the Council "to develop, adopt, and commence implementation of the Delta Plan," a comprehensive management plan for the Delta, no later than January 1, 2012.

In response to the Delta crisis, the Legislature and the Governor required development of a new, long-term strategic vision for managing the Delta. The Governor appointed a Delta Vision Blue Ribbon Task Force to develop a *Delta Vision Strategic Plan*. The *Delta Vision Strategic Plan*, submitted to the Governor and the Legislature on January 3, 2009, identified that the Delta conditions were declining due to following:

- Degradation of water resources, water quality, and ecosystem conditions in the Delta;
- Risks related to catastrophic failure of levees due to earthquakes, floods, sea level rise, and land subsidence; and

- Potential increased risks due to recent residential development in the Delta that could further degrade water resources, water quality, and ecosystem resources and increase risks to human life.

The Legislature considered these issues when identifying the state's following basic goals for the Delta:

- Achieve the two coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place.
- Protect, maintain, and, where possible, enhance and restore the overall quality of the Delta environment, including, but not limited to, agriculture, wildlife habitat, and recreational activities.
- Ensure orderly, balanced conservation and development of Delta land resources.
- Improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety.

Purpose and Use

The purpose of this white paper is to analyze past and current agricultural use in the Delta and correlated economic and ecosystem value of agricultural production. This white paper is not intended to describe the existing and projected conditions in detail. More detailed discussions of existing and projected conditions will be presented in the Delta Plan Environmental Impact Report (EIR). Draft versions of the EIR chapters that are related to the existing and projected future conditions without implementation of the Act will be provided in early 2011 for review by the Council and the public.

Most of the information in this white paper is summarized or taken directly from existing documents. This white paper does not address regulation of agriculture or recommend policy. This white paper will be considered in the development of the framework for the Delta Plan and alternatives in the Draft EIR.

Section 2
Regulation and Policy

Statutory Requirements

The Council's statutory authority and direction relative to the Delta ecosystem are contained in the objectives identified in the Act (Water Code section 85020). The Act states that the policy of the State of California is to achieve the following objectives that the Legislature declares are inherent in the coequal goals for management of the Delta:

(a) Manage the Delta's water and environmental resources and the water resources of the state over the long term.

(b) Protect and enhance the unique cultural, recreational, and agricultural values of the California Delta as an evolving place.

(c) Restore the Delta ecosystem, including its fisheries and wildlife, as the heart of a healthy estuary and wetland ecosystem.

(d) Promote statewide water conservation, water use efficiency, and sustainable water use.

(e) Improve water quality to protect human health and the environment consistent with achieving water quality objectives in the Delta.

(f) Improve the water conveyance system and expand statewide water storage.

(g) Reduce risks to people, property, and state interests in the Delta by effective emergency preparedness, appropriate land uses, and investments in flood protection.

(h) Establish a new governance structure with the authority, responsibility, accountability, scientific support, and adequate and secure funding to achieve these objectives.

The Act provided additional direction by stating that it is the policy of the State of California to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency. Each region that depends on water from the Delta watershed shall improve its regional self-reliance for water through investment in water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts (Water Code section 85022).

Agency Responsibilities

Three state agencies that have significant influence over local land use decisions in the Delta, including agricultural lands and other land uses and facilities that directly support agricultural operations, are the Delta Protection Commission (DPC), the Council, and the Bay Conservation and Development Commission (BCDC). In addition, various federal resource agencies have jurisdiction in the Delta related to their areas of responsibility.

Other state agencies that influence agricultural decisions in the Delta from a land use perspective include the California Environmental Protection Agency; the State Water Resources Control Board; the California Natural Resources Agency, including the Department of Fish and Game, Department of Conservation, and Department of Water Resources; the Central Valley Flood Protection Board; the Department of Food and Agriculture; and the State Mining and Geology Board. In addition, the California State Lands Commission has jurisdiction over lands underlying the state's water bodies and tidelands, and retains surface mineral rights and/or ownership interests over certain other lands (California State Lands Commission, 2010).

The primary federal agencies that influence land use and agricultural decisions in the Delta are the U.S. Environmental Protection Agency (USEPA), U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Marine Fisheries Service, and U.S. Department of Agriculture.

Primary and Secondary Delta

The land area within the Legal Delta is predominately within county unincorporated areas (Table 2-1). The geographic area of the Primary Zone includes five counties (Figure 2-1): Contra Costa, Sacramento, San Joaquin, Solano, and Yolo. The Primary Zone includes the following cities, towns, and villages: Clarksburg, Courtland, Hood, Knightsen, Locke, Rio Vista, Ryde, Terminous, and Walnut Grove.

The Secondary Zone encompasses the same five counties (Figure 2-1) as the Primary Zone, as well as a small portion of Alameda County. This white paper does not explore the land use designations and policy direction provided in the Alameda County General Plan (East County Area Plan) because no part of the county lies within the Primary Zone, and only a small portion of the county lies within the Secondary Zone. The Secondary Zone includes the following cities, towns, and villages: Antioch, Bay Point, Bethel Island, Bird's Landing, Brentwood, Byron, Collinsville, Discovery Bay, Freeport, Isleton, Oakley, Pittsburg, Sacramento, Stockton, Tracy, and West Sacramento.

Table 2-1
Delta Acreages by County

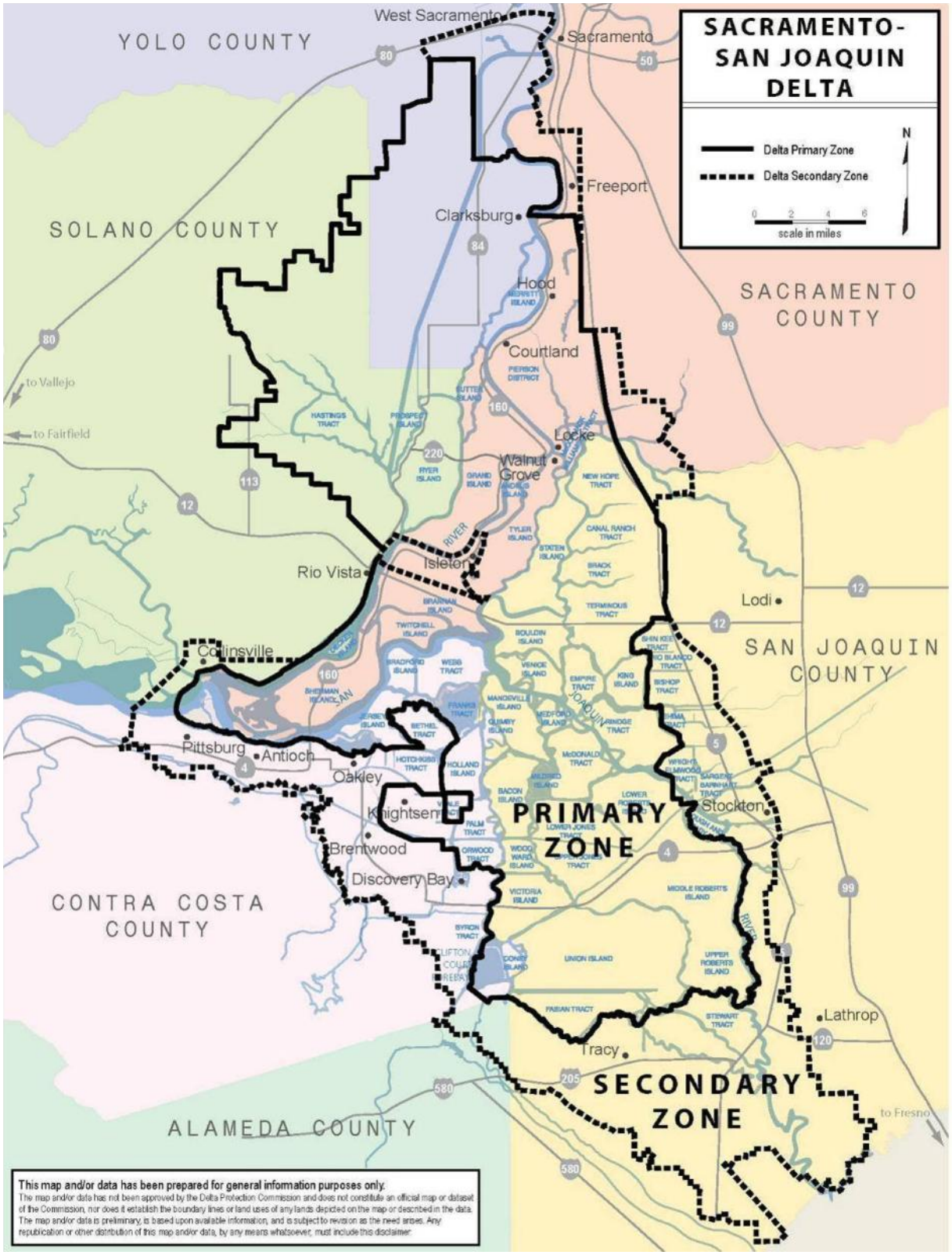
County	Total Acres	Acres in Primary	% in Primary	Acres in Secondary	% in Secondary	Acres in Statutory Delta	% in Statutory Delta
Yolo	653,080.18	74,704.22	11.4	17,309.05	2.65	92,013.27	14.09
Sacramento	635,899.75	95,490.81	15.0	22,923.24	3.60	118,414.04	18.62
Solano	582,030.06	86,171.69	14.8	6,304.23	1.08	92,475.91	15.89
San Joaquin	912,390.44	187,830.51	20.6	129,519.88	14.20	317,350.40	34.78
Contra Costa	513,719.73	45,852.20	8.9	66,621.84	12.97	112,474.03	21.89
Alameda	525,040.04	0.00	0.0	4,641.56	0.88	4,641.56	0.88
Total	**3,822,160.20**	**490,049.43**	**12.82**	**247,319.80**	**6.47**	**737,369.21**	**19.29**

Source: AECOM, 2010

1

2

Figure 2-1
Primary and Secondary Delta Zones
Source: DPC



Regulation of Agricultural Land Use

California law delegates authority to directly regulate land use to cities and counties. The primary method by which the agricultural land use is regulated in the Delta is through city and/or county general plan policies. City and county general plans include provisions to protect farmland, develop infrastructure, preserve and restore natural habitat, and concentrate future urban growth within existing city/community boundaries. Notwithstanding such policies, significant Delta acreage has been converted from agriculture to urban uses in the Delta, primarily in the Secondary Zone (see Section 3).

Each of the county general plans in the five Delta Primary Zone counties designate the Delta Primary Zone for agriculture (that is, where agriculture is the primary permitted use along with other uses consistent with agriculture), a designation that also allows open space, recreation, wildlife habitat, and nature preserves. The Delta counties have established minimum parcel sizes of 5 to 160 acres in the Delta Primary Zone to retain land in agricultural use, and most parcels are between 20 and 80 acres. The counties set parcel sizes by using their own criteria, such as soil type and other physical characteristics or "farmable unit,[2]" which contributes to inconsistent zoning among jurisdictions.

County general plan requirements may be inconsistent with DPC's *Land Use and Resource Management Plan* (LRMP) and may be changed by the county board of supervisors for specific projects (URS, 2007). County general plans have different requirements and approaches for minimum agricultural parcel sizes, the relationship of parcel sizes to soils and farming conditions, the types of uses consistent with agriculture, rural residential use of agricultural parcels, buffers and setbacks between and non-agricultural land uses, and clustering of rural residences to preserve agriculture and open space lands. These county policies address several key agriculture and land use policies in the LURMP, listed in Appendix A. However, the LURMP does not dictate details of local approaches to preserving agricultural lands nor does it require that Delta counties use exactly the same approaches. It is unclear whether county general plan policies will need to align more closely with each other to implement the intent of the LURMP related to these issues.

County general plan policies also seek to preserve important habitat lands, which can sometimes conflict with agricultural preservation (see Section 4), placing ecosystem restoration in a secondary role to agricultural uses and viability.

The counties tend to focus their planning inward, looking within their boundaries to determine the best uses for their lands and how those uses further the goals set forth by each individual county. Although the counties' general plans do not wholly ignore the concept of regionwide planning in the Delta, most of the jurisdictions do not make regional planning the main focus of their land use designations or policy direction.

County general plans may not fully address emerging issues such as future infrastructure threats or ecosystem restoration needs that are called for by the DPC, the U.S. Fish and Wildlife Service or National Marine Fisheries Service Biological Opinions, and state agency plans with jurisdiction in the Delta. Table 2-2 shows how county general plan policies align with agricultural policies in the DPC's LRMP.

Please refer to the white paper, *Delta as a Place: Land Use White Paper*, for a more complete analysis of local land use policies.

[2] A farmable unit is the estimated minimum amount of land required for commercially viable agriculture, depending on soil characteristics, value of agricultural output, and other factors.

Table 2-2
Comparison of DPC Land Use and Resource Management Plan and County General Plan Policies
● = County general plan policies align very closely with the LRMP policy
◘= County general plan policies address the LRMP policy to an extent
O = County general plan polices do not address the LRMP policy
X = County general plan policies are inconsistent with LRMP policy

DPC Land Use and Resource Management Plan Policies	Contra Costa	Sacramento	San Joaquin	Solano	Yolo
Agriculture					
P-1. Support and encourage agriculture in the Delta as a key element in the State's economy and in providing the food supply needed to sustain the increasing population of the State, the Nation, and the world.	●	●	●	●	●
P-2. Conversion of land to non-agriculturally-oriented uses should occur first where productivity and agricultural values are lowest.	◘	◘	◘	◘	◘
P-3. Promote recognition of the Delta as a place by educating individuals about the rich agricultural heritage, unique recreational resources, biological diversity, and ongoing value of maintaining a healthy agricultural economy in the Delta.	O	●	O	●	O
P-4. Support agricultural programs that maintain economic viability and increase agricultural income in accordance with market demands, including but not limited to wildlife-friendly farming, conservation tillage, and non-tillage.	◘	◘	◘	◘	◘
P-5. Local governments shall encourage implementation of the necessary plans and ordinances to: maximize agricultural parcel size; reduce subdivision of agricultural lands; protect agriculture and related activities; protect agricultural land from conversion to non-agriculturally-oriented uses. An optimum package of regulatory and incentive programs could include: (1) an urban limit line; (2) minimum parcel size consistent with local agricultural practices and needs; (3) strict subdivision regulations regarding subdivision of agricultural lands to ensure that subdivided lands will continue to contain agriculturally-oriented land uses; (4) requiring adequate buffers between agricultural and non-agricultural land uses particularly residential development outside but adjacent to the Primary Zone; (5) an agriculture element of the general plan; (6) a Right-to-Farm ordinance; and (7) a conservation easement program.	●	●	●	●	●
P-6. Encourage acquisition of agricultural conservation easements from willing sellers as mitigation for projects within each county. Promote use of environmental mitigation in agricultural areas only when it is consistent and compatible with ongoing agricultural operations and when developed in appropriate locations designated on a countywide or Deltawide habitat management plan.	◘	●	O	●	●
P-7. Encourage management of agricultural lands which maximize wildlife habitat seasonally and year-round, through techniques such as fall and winter flooding, leaving crop residue, creation of mosaic of small grains and flooded areas, wildlife friendly farming, controlling predators, controlling poaching, controlling public access, and others.	◘	◘	◘	●	◘
P-8. Encourage the protection of agricultural areas, recreational resources and sensitive biological habitats, and the reclamation of those areas from the destruction caused by inundation.	◘	◘	◘	◘	◘
P-9. Support agricultural tourism and value-added agricultural production as a means of maintaining the agricultural economy of the Delta.	O	●	O	O	●

Source: DPC, 2010

1

Section 3
History of Agriculture in the Delta

This section of the white paper provides a brief history of agriculture in the Delta, setting the background for the state of agriculture today.

Starting in 1849, the initial reports of rich gold strikes in California triggered the Gold Rush that used the Delta region as busy transportation routes bringing would-be miners and supplies to jumping-off points. By the early 1850s, many would-be miners realized that gold was hard to find and that providing supplies to the miners and food to nearby San Francisco was highly lucrative. As a result, vegetable, meat, and tallow trades boomed in the Delta and Central Valley, and family farms and labor camps grew into small agricultural communities.

Prior to the discovery of gold, the Delta had been "a vast marsh covered with tules and teeming with wildlife" (DWR, 2009). To reclaim the marsh land for agricultural use, settlers built levees and drained tidal wetlands. The early focus on reclaiming "swamp and overflow" lands was granted to the state under the federal Swamp and Overflow Lands Act of 1850. To help local landowners reclaim swamp and overflow lands, the state adopted a series of statutes authorizing them to form local reclamation districts. Levees were built around tidal marshes, and the marshes were drained, cultivated, and planted for agricultural use. Nearby uplands and seasonal wetlands (that is, grasslands, vernal pools, and floodplains)

were also cultivated for agriculture. By 1900, over half the area of the Delta (235,000 acres) was behind levees and reclaimed for agriculture, including 166,000 acres of wetlands (California Department of Public Works, 1931 in The Bay Institute, 1998). In 1930, land reclamation activities and levees were completed, with 313,000 acres of former wetlands put behind levees and drained for agricultural use (San Francisco Estuary Project, 1991; The Bay Institute, 1998).

In the Suisun Marsh, land conversion took a different turn. Most intertidal wetlands were diked to be used for farming and livestock grazing starting around 1860; however, because of subsidence and increasing salinity, most were converted to managed nontidal marsh and open-water habitat for waterfowl hunting by about 1930 (DWR, 1999).

In fewer than 100 years, from 1850 to 1930, hundreds of thousands of acres of land went into agricultural production, due in large part to the highly productive peat soils of the Delta, the introduction of mechanical farm equipment, and federal policies encouraging land reclamation.

The growth of agriculture in the Delta was steady. By 1852, the banks of the San Joaquin River were entirely occupied by small-scale farming operations. By 1883, large tonnages of garden vegetables were being shipped to San Francisco, with a day's harvest picked up by steamers that landed at San Francisco the morning after harvest from nearby fields and orchards. In the early 1900s, field corn, sugar beets, celery, and onions were being grown in the San Joaquin region, and asparagus and sugar beets became more prevalent in the Sacramento River districts of the Delta. Over the next 50 years, the Delta asparagus crop represented approximately half of the nation's production (Thompson, 1957).

Brief History of Agriculture in the Delta

1849	The gold rush begins.
1850	The Swamp and Overflow Lands Act of 1850 is enacted.
1850s	Failed miners begin settling the Delta, and the state helps to build levees that allow reclamation of swamp and overflow land for agriculture.
1880s	Delta agriculture is supplying large tonnages of vegetables to San Francisco.
Early 1900s	Field corn, sugar beets, celery, and onions are being grown in the San Joaquin region, and asparagus and sugar beets became more prevalent in the Sacramento River districts of the Delta.
1900-1950s	Asparagus grown in the Delta accounts for half of the nation's production.
1930	Land reclamation and levees are completed.
1970s to Current	Population centers experience growth, and agricultural land is converted to urban uses.

Until the 1970s, population centers in the Delta were primarily limited to historic town sites near industrial centers. Rapid urbanization associated with substantial population growth increased the demand for developable land, particularly in areas near the Bay Area, Stockton, and Sacramento. This demand has resulted in the conversion of open space, primarily agricultural land, to residential and commercial uses, greatly reducing the buffers between agriculture and developed areas along the periphery of the Delta. Between 1990 and 2004, approximately 39,000 acres of agricultural land were converted to urban and other uses in the larger Delta-Suisun Marsh area (DWR, 2007b).

Today, agriculture is the dominant land use of the Delta, comprising three-quarters of the region's landscape. It was for agriculture that reclamation of the Delta's lowlands began in the 1850s, with the support of state funding and policies. Because of the fertile peat soils and the moderating marine influence, Delta agriculture's per-acre yields are almost 50 percent higher than the state's average. This unique growing region supports a diverse array of crops from such high-value commodities as pears, wine grapes, asparagus, turf-grass, cherries, tomatoes, and blueberries to lower risk and value field crops as corn, hay, small grains, and pasture.

Farmland Categories and Acreage

Various criteria and methods are used to evaluate the significance and quality of agricultural land and promote the continuation of agricultural and open space uses. California Department of Conservation's Division of Land Protection administers the Farmland Mapping and Monitoring Program (FMMP) to analyze the impacts on agricultural resources. Farmland categories are described further in Appendix B and are as follows:

- Prime Farmland—land with the best combination of physical and chemical characteristics for the production of crops.
- Farmland of Statewide Importance—land, other than Prime Farmland, with a good combination of physical and chemical characteristics for the production of crops.
- Unique Farmland—land that has been used for the production of specific high economic-value crops but does not meet the criteria for Prime Farmland or Farmland of Statewide Importance.
- Farmland of Local Importance—land that is either currently producing crops, has the capability of production, or is used for the production of confined livestock, other than Prime Farmland, Farmland of Statewide Importance, or Unique Farmland.
- Grazing Land—land on which the existing vegetation, whether grown naturally or through management, is suitable for grazing or browsing of livestock (the minimum size for mapping purposes is 40 acres).

In addition, the FMMP defines several categories of nonagricultural lands, including Urban and Built-up Land, Other Land, and Land Committed to Nonagricultural Use.

- Agriculture represents 75% of Delta land.
- About half of Delta land is Prime Farmland.
- The total acreage of Delta farmland declined by over 11% between 1984 and 2008.

Agriculture is currently the principal land use in the Delta. Total acreage in agricultural lands has declined from about 597,400 acres in 1984 to about 531,010 acres in 2008. This decline in acreage has resulted in a decreased percent of agricultural land in the Delta, from about 80 percent of the Delta's total land area in 1984 to about 74 percent in 2008. About 75 percent of the Delta's total land area is classified as Prime Farmland, which is defined as land with the best physical and chemical characteristics, and a reliable irrigation water supply. By comparison, only 18 percent of the entire state's agricultural land is classified as Prime Farmland. Urban uses comprised 7 percent of the Legal Delta's land area in 1984, increasing to just less than 10 percent in 2008. Water and nonagricultural open space uses balance out the Delta's landscape (Trott, 2010; FMMP).

Land use changes in the Delta can be seen when analyzing the historical designation of important farmlands in the Delta over a longer period of time. In 1984, approximately 564,160 acres of important farmland were in the Legal Delta. In 2008, approximately 503,920 acres of important farmland were in the Legal Delta. Between 1984 and 2008, approximately 60,235 acres of Prime Farmland, Farmland of Statewide Importance, Farmland of Local Importance, Farmland of Potential Local Importance, and Unique Farmland have been lost to urban development in the Legal Delta (see Tables 3-1 and 3-2, and Figure 3-1). Appendix C contains more detailed information on agricultural land by county.

Table 3-1
Delta Farmland in 1984

Farmland Type	Total Acres*	Primary Acres	Secondary Acres	Legal Delta Acres
Prime Farmland	1,007,069	325,142	120,714	445,857
Farmland of Statewide Importance	220,217	30,570	25,660	56,231
Unique Farmland	134,320	27,176	15,697	42,873
Farmland of Local Importance	176,570	8,575	10,612	19,186
Farmland of Potential Local Importance	2,721	-	16	16
Grazing Land	1,191,145	21,784	7,634	29,420
Urban and Built-Up Land	509,806	2,131	48,691	50,821
Other Land	401,377	24,746	12,615	37,362
Water	191,959	50,135	5,775	55,910
Total	**3,835,184**	**490,259**	**247,414**	**737,676**

Source: FMMP, 1984

Note: All acreages rounded to nearest whole number.

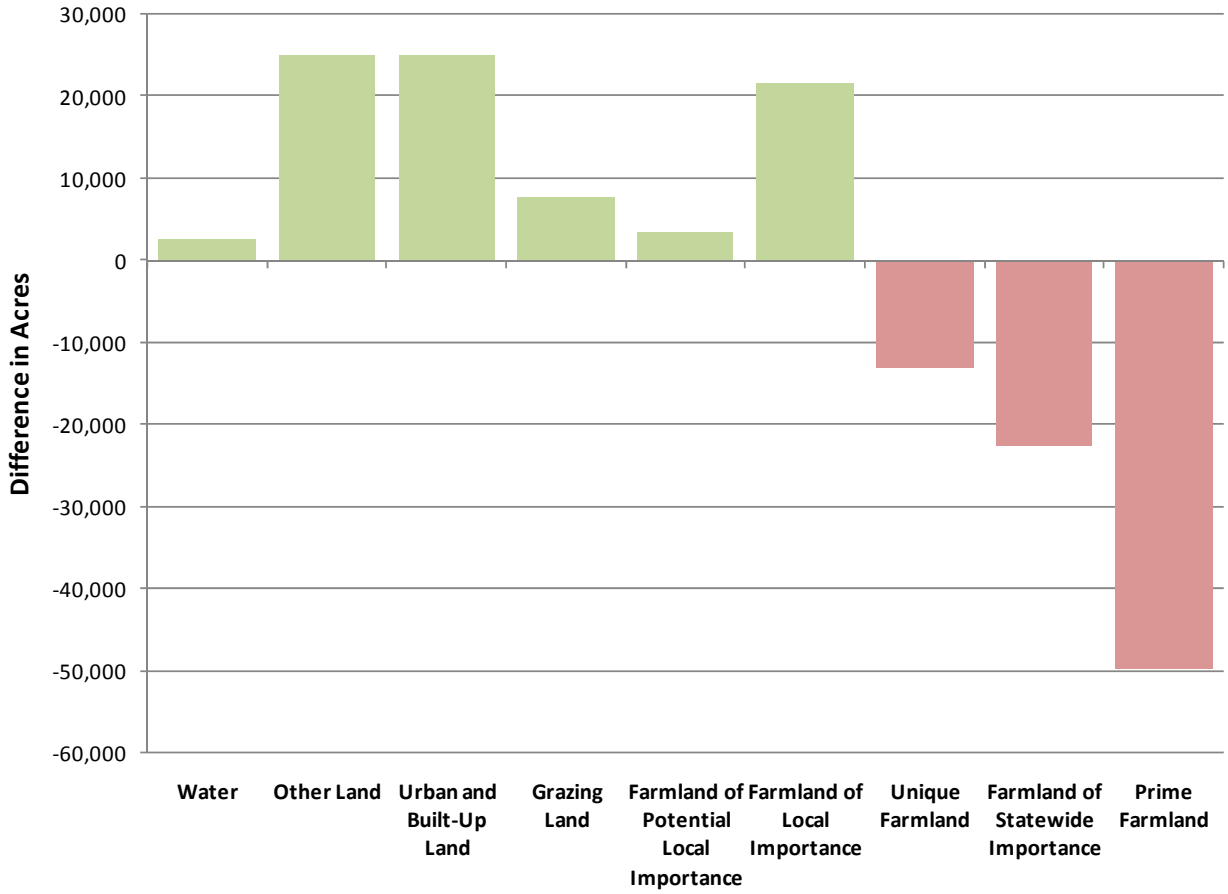
Table 3-2
Delta Farmland in 2008

Farmland Type	Total Acres	Primary Acres	Secondary Acres	Legal Delta Acres
Prime Farmland	923,027	303,318	92,859	396,176
Farmland of Statewide Importance	168,445	18,232	15,505	33,734
Unique Farmland	143,925	19,526	10,165	29,691
Farmland of Local Importance	191,505	22,957	17,881	40,838
Farmland of Potential Local Importance	26,345	1,925	1,558	3,483
Grazing Land	1,074,242	28,987	8,142	37,129
Nonagricultural or Natural Vegetation	23,140	11,205	3,213	14,417
Other Land	384,834	25,908	13,934	39,843
Confined Animal Agriculture	5,552	201	1,343	1,544
Rural Residential Land	14,582	129	1,274	1,404
Semi-Agricultural and Rural Commercial Land	4,048	889	712	1,601
Urban and Built-Up Land	655,240	3,430	72,402	75,833
Vacant or Disturbed Land	10,372	683	2,812	3,495
Water	198,589	52,869	5,617	58,486
Total	**3,823,846**	**490,259**	**247,417**	**737,674**

Source: FMMP, 2008

Note: All acreages rounded to nearest whole number.

Figure 3-1
Change in Delta Farmland between 1984 and 2008
Source: FMMP, 1984 and 2008; Adapted by AECOM, 2010



Figures 3-2 and 3-3 illustrate how land use patterns have changed over time. As shown, the amount of urban land on the periphery of the Delta near Oakley, Brentwood, Tracy, and Lathrop increased noticeably from 1984 to 2008. These figures clearly show an increase in the acreage for urban land uses (primarily in the Secondary Zone and adjacent to the Delta) and a corresponding decrease in agricultural lands.

Figure 3-2
Delta Farmland in 1984
Source: FMMP, 1984

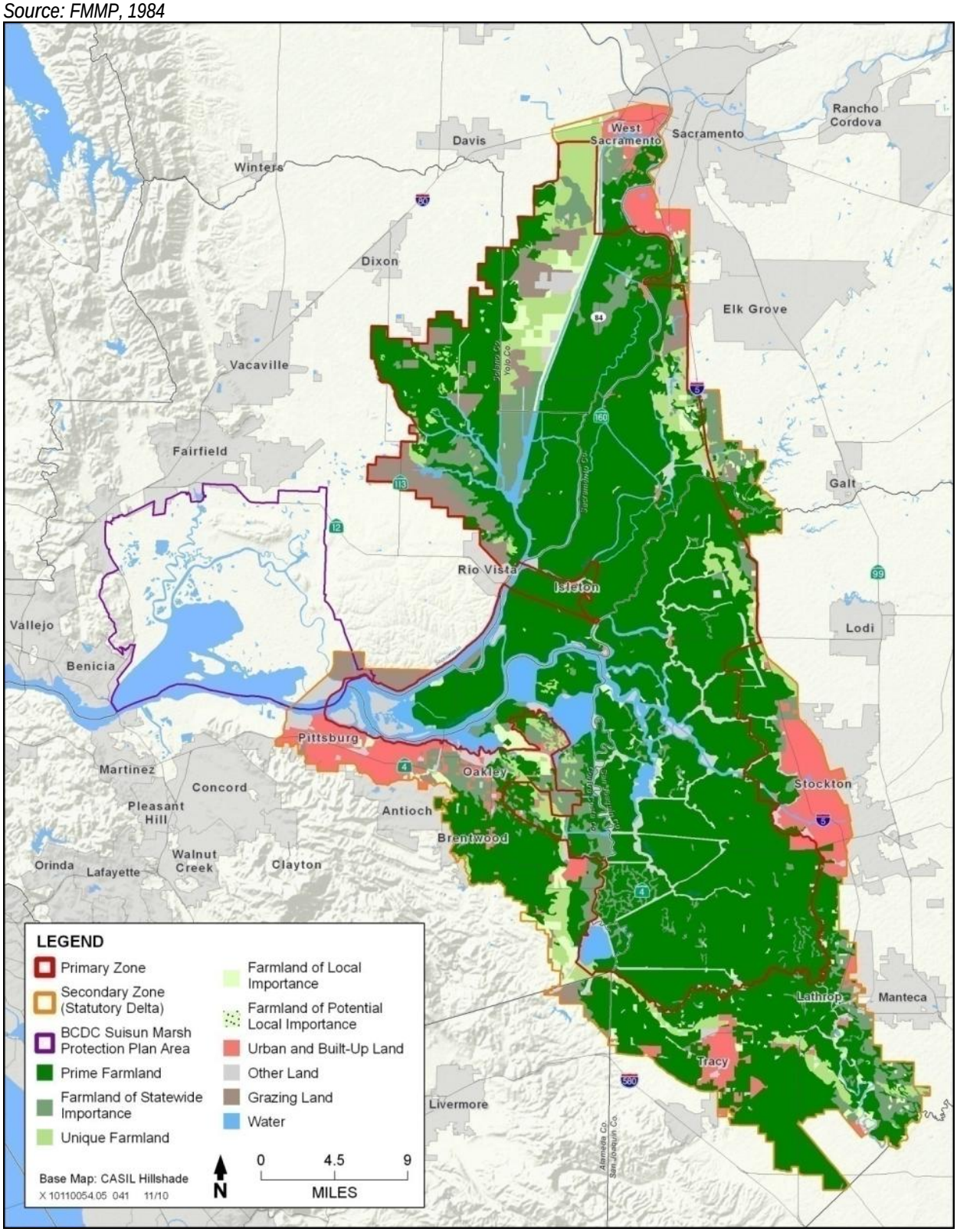
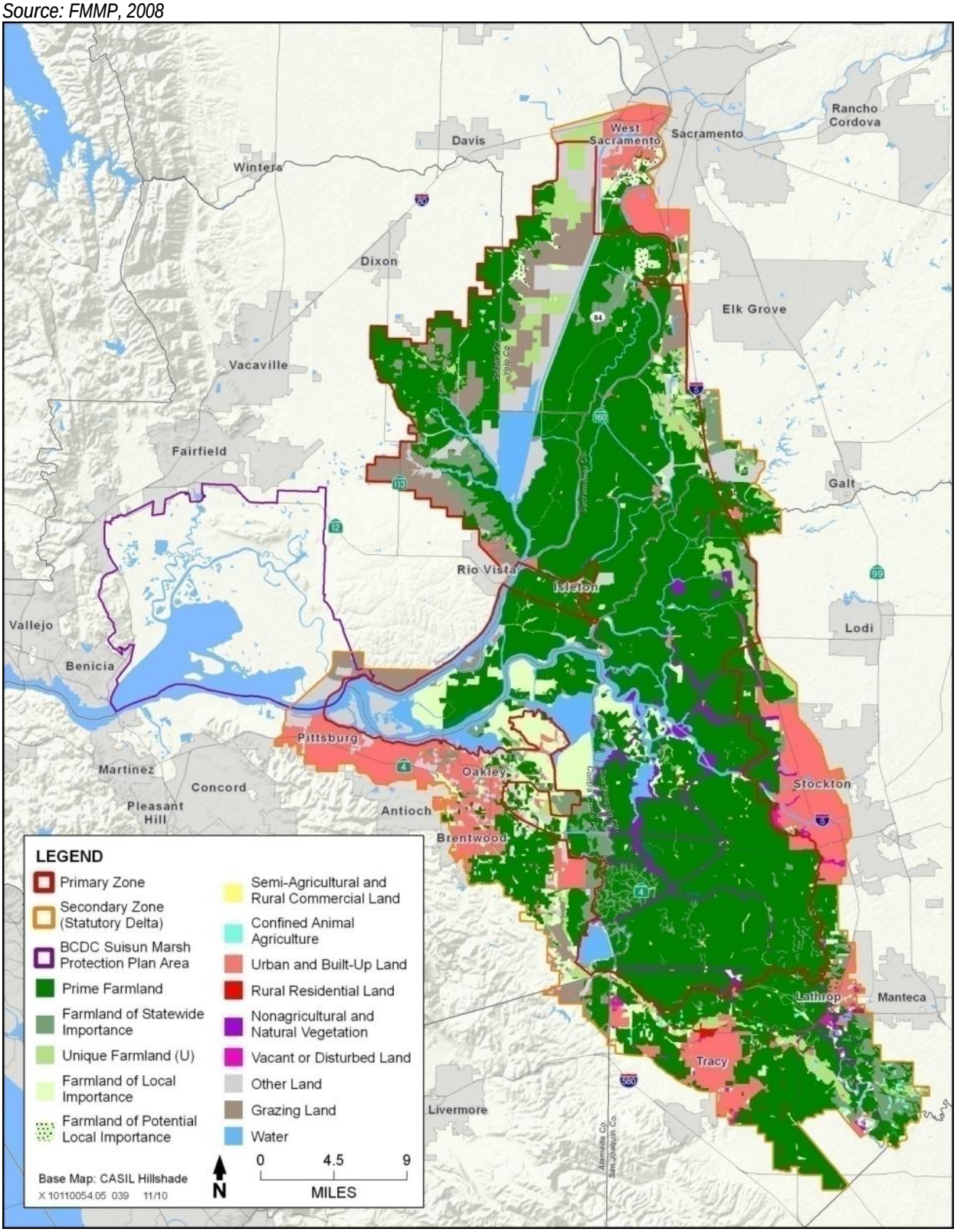


Figure 3-3
Delta Farmland in 2008
Source: FMMP, 2008



Williamson Act

Much of the farmland in the Delta is enrolled in a state program, the California Land Conservation Act of 1965, which provides property tax reductions in exchange for maintaining land in agricultural use. This program, also called the Williamson Act, allows cities and counties to enter into contracts with private landowners for the purpose of restricting specific parcels of land to agricultural or related open space use. In return, landowners receive property tax assessments that are much lower than normal because they are based on farming and open space uses in contrast to full market value. Local governments receive an annual subvention of forgone property tax revenues from the state via the Open Space Subvention Act of 1971. (State payments were significantly reduced several years ago and were halted when the state stopped subvening funds in the 2009-2010 fiscal year because of the state's budget problems.)

The Williamson Act protects agricultural land through the establishment of conservation easements. In 2009, approximately 366,840 acres of land were under Williamson Act contracts (see Table 3-3). Williamson Act lands are shown graphically on Figure 3-4. Data to evaluate potential changes in acreage of land under Williamson Act contract were not available at this time[3].

Table 3-3
Delta Williamson Act Lands in 2009

Williamson Act Contract Land	Total Acres	Primary Acres	Secondary Acres	Legal Delta Acres
Alameda County				
Non-Prime Ag Land	138,582	0	1,285	1,285
Non-Prime Non-Renewal Ag Land	1,644	0	0	0
Prime Ag Land	3,227	0	0	0
Prime Non-Renewal Ag Land	3	0	0	0
Contra Costa County				
Non-Prime Ag Land	38,587	429	530	959
Non-Prime Non-Renewal Ag Land	3,465	0	0	0
Prime Ag Land	5,167	3,748	746	4,494
Prime Non-Renewal Ag Land	1,088	925	132	1,058
Sacramento County				
Non-Prime Ag Land	84,895	544	912	1,456
Non-Prime Non-Renewal Ag Land	6,441	0	0	0
Prime Ag Land	91,147	43,778	7,813	51,591
Prime Non-Renewal Ag Land	3,968	275	0	275
Mixed Prime and Non-Prime	1,035	818	0	818
Home Site	109	44	2	46
San Joaquin County				
Farmland Security Zone	62,981	29,511	2,533	32,044
Mixed Prime and Non-Prime	429,874	106,445	30,013	136,458
Mixed Prime Non-Renewal	47,539	12,150	11,564	23,714

[3] Historical Williamson Act data are available on a per-county basis. Not all counties had historical data available at the time this report was prepared.

Table 3-3
Delta Williamson Act Lands in 2009

Williamson Act Contract Land	Total Acres	Primary Acres	Secondary Acres	Legal Delta Acres
Solano County				
Non-Prime Ag Land	142,109	11,611	714	12,325
Non-Prime Non-Renewal Ag Land	1,737	0	0	0
Non-Prime Ag Conservation Easement	2,760	0	0	0
Prime Ag Land	112,576	50,512	0	50,512
Prime Non-Renewal Ag Land	1,196	0	0	0
Prime Ag Conservation Easement	733	0	0	0
Mixed Prime and Non-Prime	8,926	5,314	0	5,314
Mixed Prime and Non-Prime Non-Renewal	107	0	0	0
Mixed Ag Conservation Easement	773	0	0	0
Yolo County				
Non-Prime Ag Land	151,556	1,846	0	1,846
Non-Prime Non-Renewal Ag Land	3,081	4	0	4
Prime Ag Land	239,316	40,445	1,172	41,616
Prime Non-Renewal Ag Land	9,291	510	0	510
Mixed Prime and Non-Prime	4,453	516	0	516
Total	**1,598,366**	**309,425**	**57,416**	**366,841**

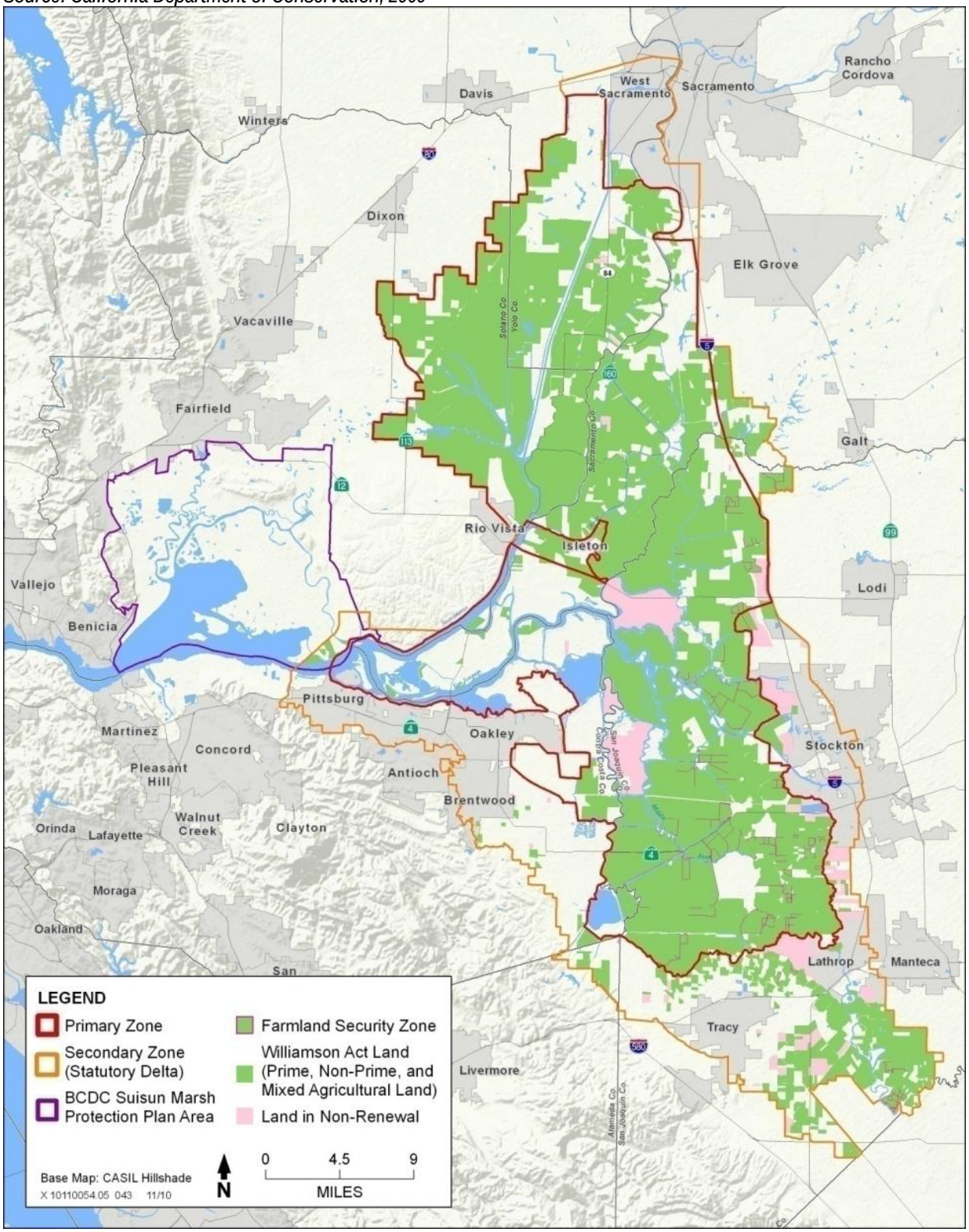
Source: California Department of Conservation, 2009

Note: All acreages rounded to nearest whole number.

1

2

Figure 3-4
Delta Williamson Act Lands in 2009
Source: California Department of Conservation, 2009



Section 4
Economic Value of Agriculture

Overview

This section of the white paper describes the Delta's contribution to California and the Delta region's agricultural economy. California's economy ranks eighth in the world (EconPost, 2009), with about $1.9 trillion in gross domestic product (GDP) in 2009. Crop and animal production comprises almost one percent of the state's total GDP (Bureau of Economic Analysis, 2010). California is the leading agricultural producer in the nation, with 14 percent of the nation's agricultural GDP and more than twice as much agricultural GDP than the next state, Texas. Although the value of California's agricultural production is large, approximately

QUICK FACTS

- California agriculture represents:
  - 17% of national agricultural output,
  - $12.9 billion agricultural export value,
  - $34 billion of production value added (2009), and
  - 2% of the State Gross Domestic Product (2009).
- The Central Valley contributes 2/3 of state agriculture value.
- The value of Delta agriculture represents:
  - about $700 million, and
  - 1/4 of five-county region's agricultural output.
- 41 of 55 top-value crop exports grow in the Delta.
- Agriculture comprises 15% of Delta employment.

$38 billion in 2009 (U.S. Department of Agriculture, 2010), this represents about 2 percent of California's estimated gross domestic product in 2009 ($1.9 trillion) (Bureau of Economic Analysis, 2010). The total value of agriculture to California's economy exceeds the figures cited above. Although hard to measure, agritourism, research and development, and other indirect economic activities related to agriculture also add to the state's economy. Aside from the direct and indirect dollar value of agriculture, most industrial societies value their agricultural roots and derive enjoyment from the aesthetic and cultural value of agricultural landscapes, even as fewer people work the land and directly derive their incomes from farming. Thus, the value of agriculture in California and America is not simply an economic calculation. California agriculture plays a very important role in our state, nation, and internationally, beyond the total dollar value of agricultural output.

Although the exact contribution from the Delta to the state's GDP is unknown[4], the value per acre contribution is greater than other agricultural regions in the state. Even as the acres of farmland have declined, the value of agricultural products in the Delta has continued to increase as farmers have changed to higher value crops. In addition, "virtually every one of the crops from this diverse Delta agricultural palette, from field crops to blueberries, produces greater yields and fetches higher per unit prices than do most other growing regions of these crops in the state" (California Department of Food and Agriculture, 2008). It has been estimated that the Central Valley region, including the Delta, contributes two-thirds of the state's agricultural value (Trott, 2007). The five-county Delta region has consistently contributed (in 2007 dollars) more than $2 billion annually in agricultural gross value (Trott, 2008), and the most recent estimates indicate that the Legal Delta area contributes almost 25 percent of that (DWR, 2007c) on 20 percent of the land (Trott, 2007).

The Delta is not alone in changing its crop mix towards higher value permanent crops. Other agricultural regions in the state have also shifted from field crops to vineyards and trees. Although a shift has been made towards higher value crops, it has been observed that farmers in the Delta are less likely to plant permanent crops because of flooding risks. The area within the Delta has a higher percentage of field crops and a lower percentage of permanent crops such as vineyards and trees.

In 2007, corn and alfalfa were two of the Delta's top crops (Table 4-1). Both of these crops contributed a large proportion to the overall value and overall agricultural acres; however, neither is a top grossing export from California. The list of top exports from California was compared to a 2008 draft of DWR's 2007 Land Use Survey (DWR, 2008). Delta agriculture contributes to 41 out of the 55 top-value crop exports in California. A few additional commodities may be found in the Delta. Commodities such as turkey and eggs are likely products of Delta agriculture, but no information on these was available for comparison. Some commodities such as raisins and cottonseed byproducts may be created from Delta crops, but that information is also not known.

Table 4-1
Top Five Crops in the Delta

Position (2007)	By Gross Value	By Acres Grown	By Gross Value of Exports from California
1	Asparagus	Corn	Almonds
2	Tomatoes	Alfalfa	Dairy and products
3	Corn	Grain and Hay	Wine
4	Grapes	Safflower	Table grapes
5	Alfalfa	Pasture	Pistachios

[4] GDP data are available for regions, including Stockton Metropolitan Statistical Area. However, no data are available for the Delta or five-county area.

Agricultural Employment

Within the five primary Delta counties, about 26,000 jobs were in agriculture in 2009 (California Employment Development Department). Of these agricultural jobs, nearly 25 percent are in the Delta. As shown on Figure 4-1 (next page), in 2007, agriculture accounted for about 2 percent of total employment in the five Delta counties (Contra Costa, Sacramento, San Joaquin, Solano, and Yolo). After increasing by 2.4 percent between 1990 and 2000, agricultural employment in these counties declined by over 11 percent between 2000 and 2009. By contrast, overall employment in these counties increased 20.5 percent between 1990 and 2000, and 0.9 percent between 2000 and 2008. Figure 4-2 (next page) shows that, within the Delta itself, agriculture accounts for about 4.4 percent of total employment (38 percent of employment in the Primary Zone). Agricultural employment declined in the Delta by 27 percent between 2002 and 2008 (40 percent in the Primary Zone), compared to a modest increased in total employment (Bay Area Economics, 2010)[5].

Including agricultural employment, the Delta is home to approximately 146,000 jobs. The number of jobs in the Delta increased at an average annual rate of 1.3 percent per year between 2002 and 2008, about half the rate of employment growth during the previous decade (2.7 percent annually). Some notable employment trends in the Delta are summarized below (Bay Area Economics, 2010).

- The sectors with the largest numbers of employees are education services, retail trade, and health care and social assistance.
- Agriculture accounts for 4.4 percent of jobs in the Delta.
- The Primary Zone is home to approximately 7,400 jobs.
- This number of jobs accounts for 5 percent of total jobs in the Delta.
- By far, the sector with the largest number of workers in the Primary Zone is agriculture, accounting for approximately 2,800 jobs, or 38 percent of the Primary Zone total.
- The other key sector is accommodation and food service (approximately 1,700 jobs or 23 percent of the Primary Zone total).
- The Secondary Zone is home to approximately 139,000 jobs.
- This Secondary Zone contains 95 percent of total jobs in the Delta.
- The sector with the largest number of jobs in the Secondary Zone is education services (19,000 jobs or 14 percent of the Secondary Zone).
- Other service-related sectors, including retail and health care, also employ significant numbers of individuals.
- In addition, the Secondary Zone includes a significant manufacturing sector (10,000 jobs).

Although agriculture represents one of the smaller employment sectors in Delta counties (similar in magnitude to arts, entertainment, and recreation), agriculture represents a much larger percentage of employment within the Delta itself. However, agricultural employment declined in the Delta between 2002 and 2008, while overall employment and agricultural exports increased (see Agricultural Exports section below). It is hard to tell from these data whether this decline is temporary due to a weak economy or a long-term trend related to a decline in the acreage in agriculture, changes in the types of crops grown, and/or changes in the efficiency of agricultural operations in the Delta

[5] No similar data for 1990 or 2000 were available from published sources at the time this report was prepared.

Figure 4-1
Changes in Employment – Delta Counties (1990–2009)
Source: California Employment Development Department, 2010

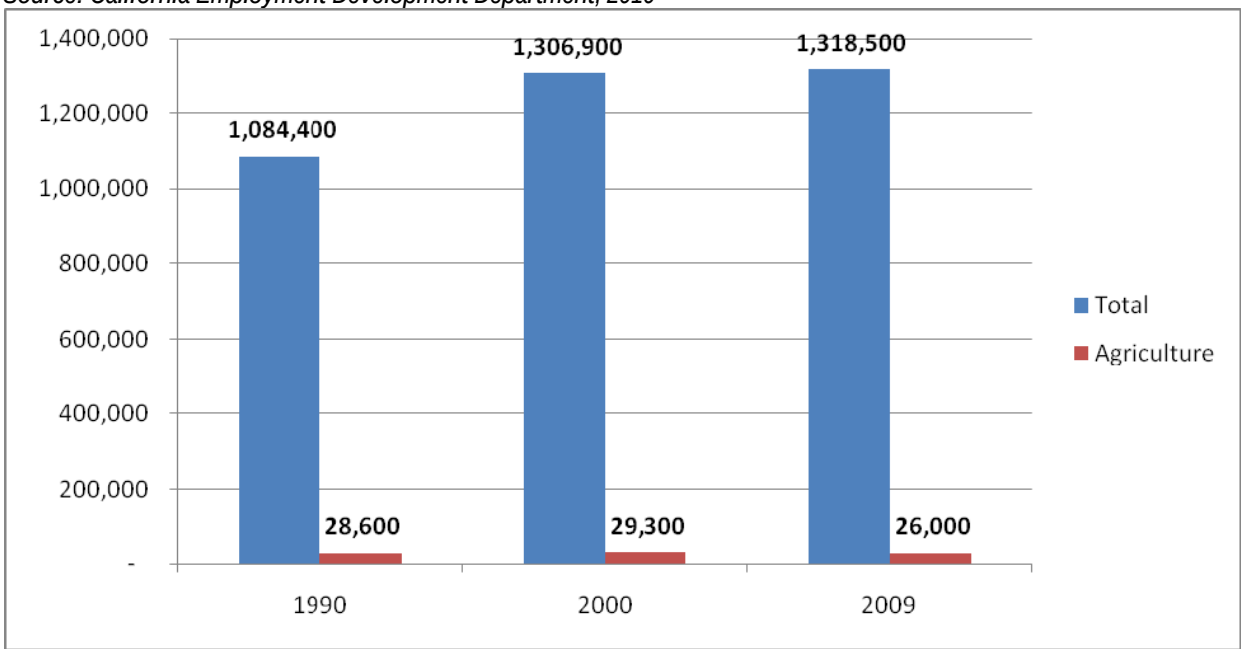
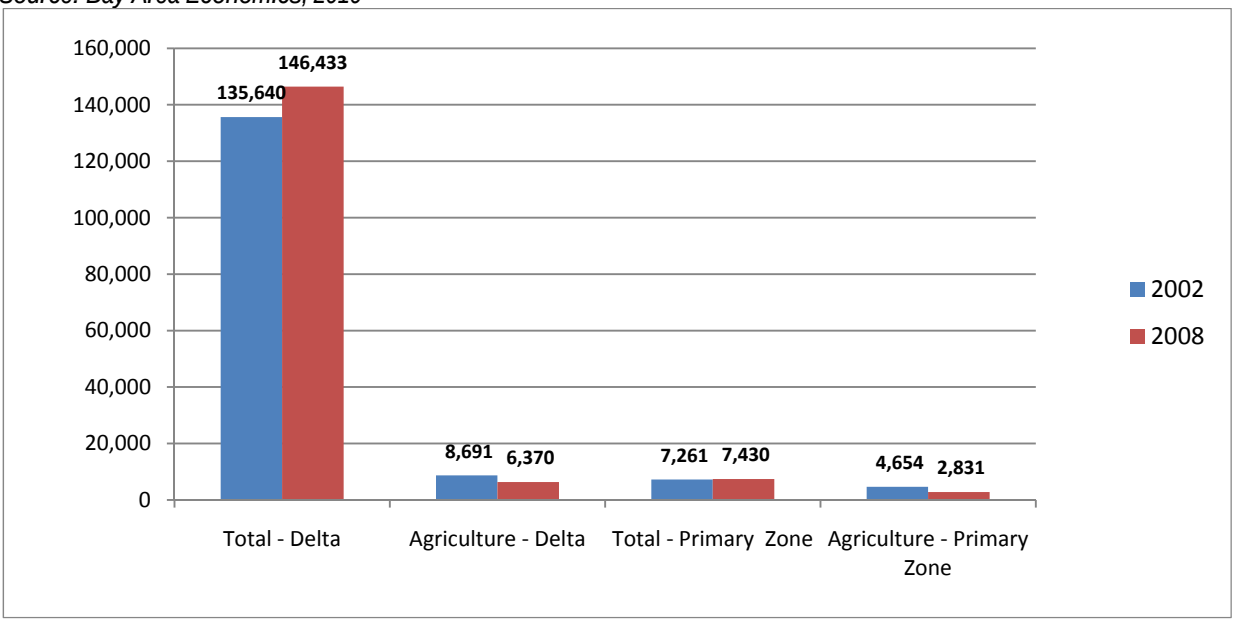
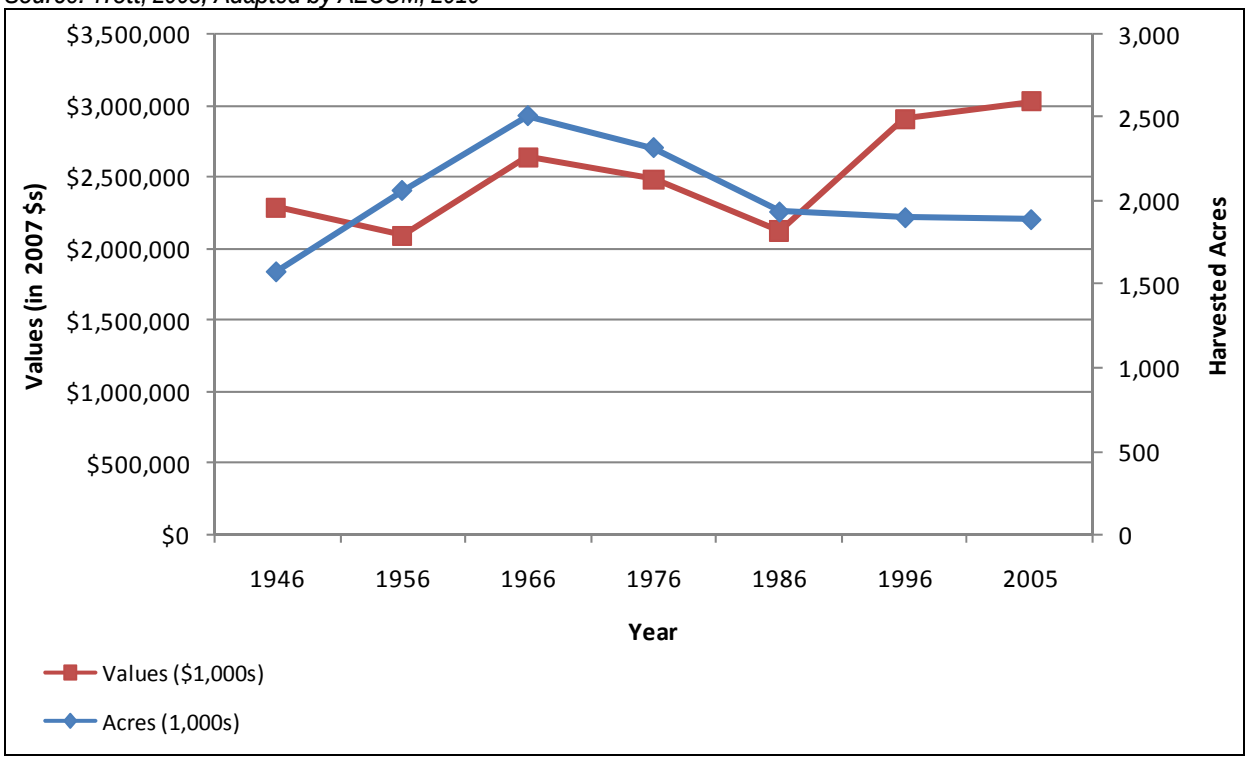


Figure 4-2
Changes in Employment in the Delta (2002 and 2008)
Source: Bay Area Economics, 2010



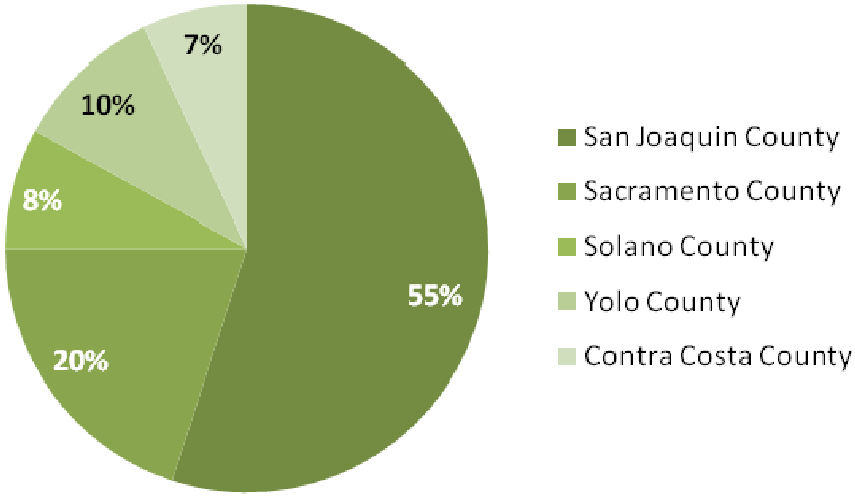
The Delta has been a major agricultural producer for years. As shown on Figure 4-3, the entirety of the five-county Delta region has consistently contributed (in 2007 dollars) more than $2 billion in agricultural gross value. Even as the acres of harvested farmland have declined, the value of agriculture has continued to increase. It has been noted that a "shift to higher-valued crops by many Delta farmers has meant that the real, price-level adjusted value of Delta agricultural output increased" (DWR, 2007a). This shift towards higher value crops has also been observed in other agricultural regions.

Figure 4-3
Values and Acres of Farmland
(Total of Delta Counties)
Source: Trott, 2008; Adapted by AECOM, 2010



As of 2008, the five primary Delta counties comprised a total of 2.3 million acres of agricultural land. Over half of Delta-irrigated acreage is in San Joaquin County; Sacramento County has the second largest share, with the remainder split among Contra Costa, Solano, and Yolo counties (Figure 4-4). Adjacent to the Suisun Marsh in wetlands and lowland grasslands, grazing and grain crops are the primary agricultural land uses.

Figure 4-4
Delta Farmland per County
Source: Source: Trott, 2007; Adapted by AECOM, 2010



Crop Types and Value

According to recent county agricultural commissioners' annual crop reports, more than 90 plant and animal products are produced by one or more of the Delta's five counties (Trott, 2007). Figure 4-5 shows the location of these crops within the Legal Delta. Acreages of irrigated crops can be seen in Table 4-2.

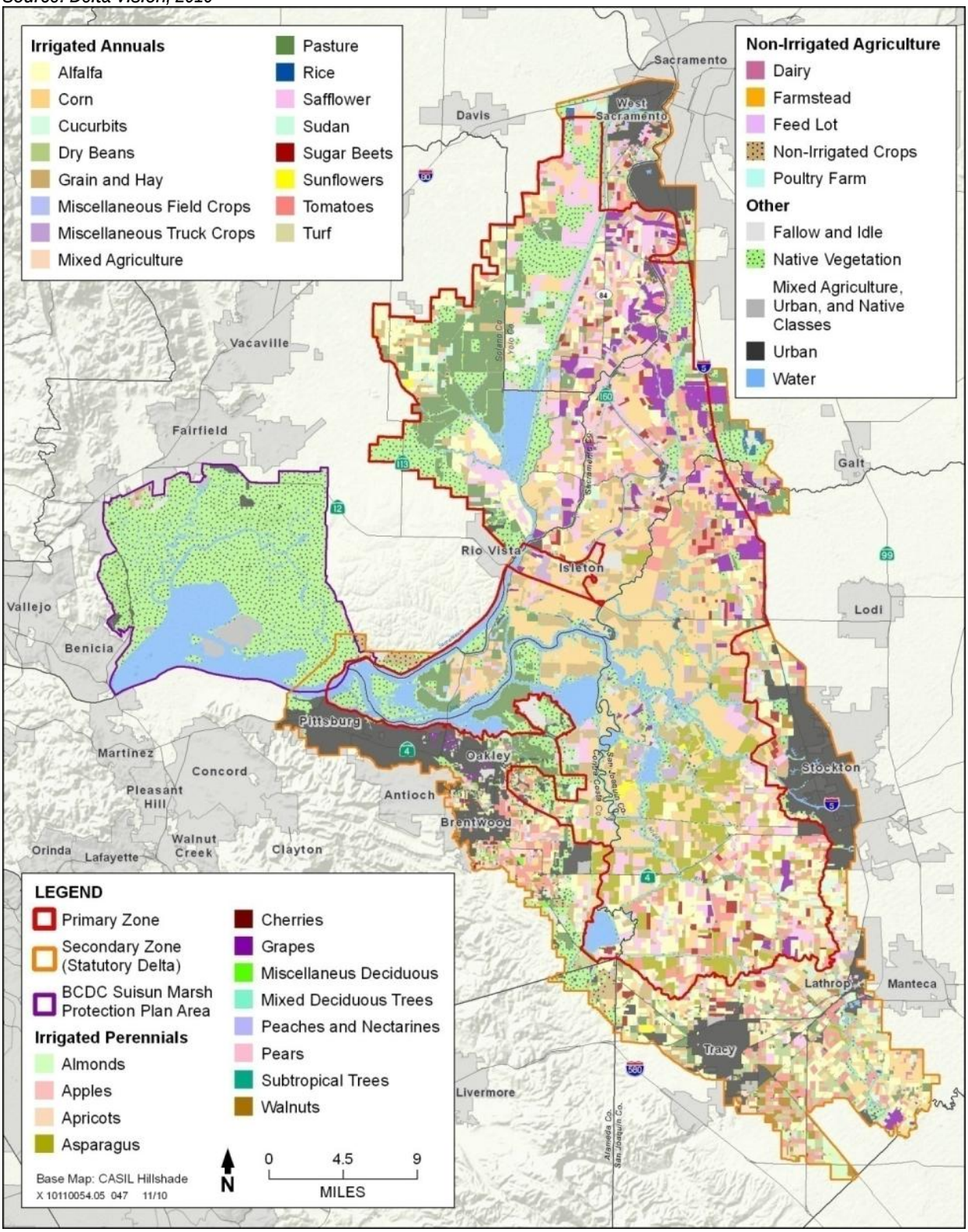
Table 4-2
Crop Acreages and Value in the Legal Delta, 2007

Crop Type	Acreage	Value per Acre ($)	Estimated Annual Value ($1,000s)
Irrigated Crops			
Asparagus	24,064	3,501	84,248
Tomatoes	37,850	2,121	80,280
Corn	114,108	591	67,438
Grapes	22,095	2,903	64,142
Alfalfa	69,868	907	63,370
Miscellaneous Truck Crops	7,199	5,255	37,831
Pears	7,621	4,060	30,941
Turf	1,630	15,151	24,696
Cucurbits	6,424	3,641	23,390
Apples	2,435	8,597	20,934
Safflower	50,157	333	16,702
Grain and Hay	51,343	297	15,249
Walnuts	5,170	2,713	14,026
Sugar Beets	7,770	1,257	9,767
Almonds	2,472	3,689	9,119
Rice	7,298	1,008	7,356
Dry Beans	10,140	724	7,341
Apricots	2,041	3,025	6,174
Cherries	739	8,354	6,174
Miscellaneous Deciduous	1,060	4,902	5,196
Pasture	42,863	113	4,844
Sudan	4,753	666	3,165
Peaches and Nectarines	309	5,263	1,626
Sunflowers	1,850	690	1,277
Subtropical Trees	81	9,388	760
Miscellaneous Field Crops	2,326	228	530
Livestock Production			90,638
Total	**483,666**		**697,214**

Source: DWR, 2007c; AECOM, 2010

Annual crop reports (2005–2007) for the five counties were used to estimate the per-acre value of each crop. Each county reports average crop yields and prices for the entire county, not specifically for the Delta. However, crop markets are regional rather than specific to a subregion of a county, so the countywide averages for crop prices are representative.

Figure 4-5
Location of Crops within the Legal Delta
Source: Delta Vision, 2010



As seen in Table 4-2, the top grossing irrigated crops were, in order, asparagus, tomatoes, corn, grapes, and alfalfa. Livestock production in the Delta includes feed lots, dairies, and poultry farms. A DWR economist estimated that livestock production in the Delta represented 13 percent of the total value of agricultural production over the period from 1998–2004 (DWR, 2007a). Assuming that this percentage is still reasonably accurate, livestock would provide an additional $90.6 million per year, for an annual total of $697 million in crop and livestock value in 2007. In 2005, the five-county Delta region had an annual agricultural gross value of $3 billion (in 2007 dollars) (Trott, 2008). Agriculture gross value in the Legal Delta accounts for approximately one-quarter of the total five-county region. Table 4-3 shows the crop value within the Delta for three data points. Because of differences in analysis there is no clear upward or downward trend in crop value evident in these data.

Table 4-3
Gross Crop Value in the Delta

Year	Gross Value ($ Millions)
1985[a]	555.6
1998–2004 (Averaged)[a]	667.8[b]
2007[c]	606.6

Note: The data for 1985 and 1998–2004 covered the Delta Service Area, and the 2007 data covered the Legal Delta.

[a] DWR, 2007a

[b] These data were adjusted to account for a higher per-acre value of wine grapes in three of the five Delta counties.

[c] DWR, 2007c

For the period 1998–2004, the same DWR economist averaged the acres of crops grown and the values of each crop. During that time, the top crops were wine grapes, livestock and poultry products (mainly milk and cream), asparagus, processing tomatoes, and alfalfa hay (DWR, 2007a). It is likely that corn has increased in value and acreage as the demand for ethanol has increased (U.S. Department of Agriculture, 2007).

Wine grapes from inside the Delta in these counties typically command substantially higher prices than the grapes from outside the Delta in these counties, where most of the wine grape acreage lies. (Delta wine grape growers benefit from rich organic Delta soils and cooling Delta breezes, which help produce superior grapes.) So as to avoid undervaluing Delta wine grape production, the 1998–2004 data were adjusted to make them more reflective of the higher Delta wine grape values (DWR, 2007a)[6].

Crop Mix

A 2007 study examined crop types and the difference between the crop mix grown in the Delta and the crop mix in the Delta counties (Figures 4-6 and 4-7). This research compared 1985 with the averaged 1998–2004 data. Unfortunately, more recent data are not available. The Delta has seen a significant shift to higher value permanent crops, such as fruit trees, nuts, and vineyards. It is important to note that orchards, vineyards, and nursery crops in the Delta have increased in value since 1985. This was at a faster rate in comparison to the county data. The crop mix in the Delta is still not as tilted towards permanent crops as within the non-Delta county areas. Table 4-4 shows more detailed data of these differences.

[6] The 2007 estimated grape value is not comparable to the DWR 1998-2004 estimates because estimates for revenue from Delta wine grapes in Sacramento, San Joaquin, and Solano counties [were] adjusted upwards by 15, 25, and 10 percent, respectively, from the revenue estimates based on County Crop Report data for wine grapes for the entire county.

Figure 4-6
Change in Crop Revenue by Type 1985/1998–2004
Source: DWR, 2007a; Adapted by AECOM, 2010

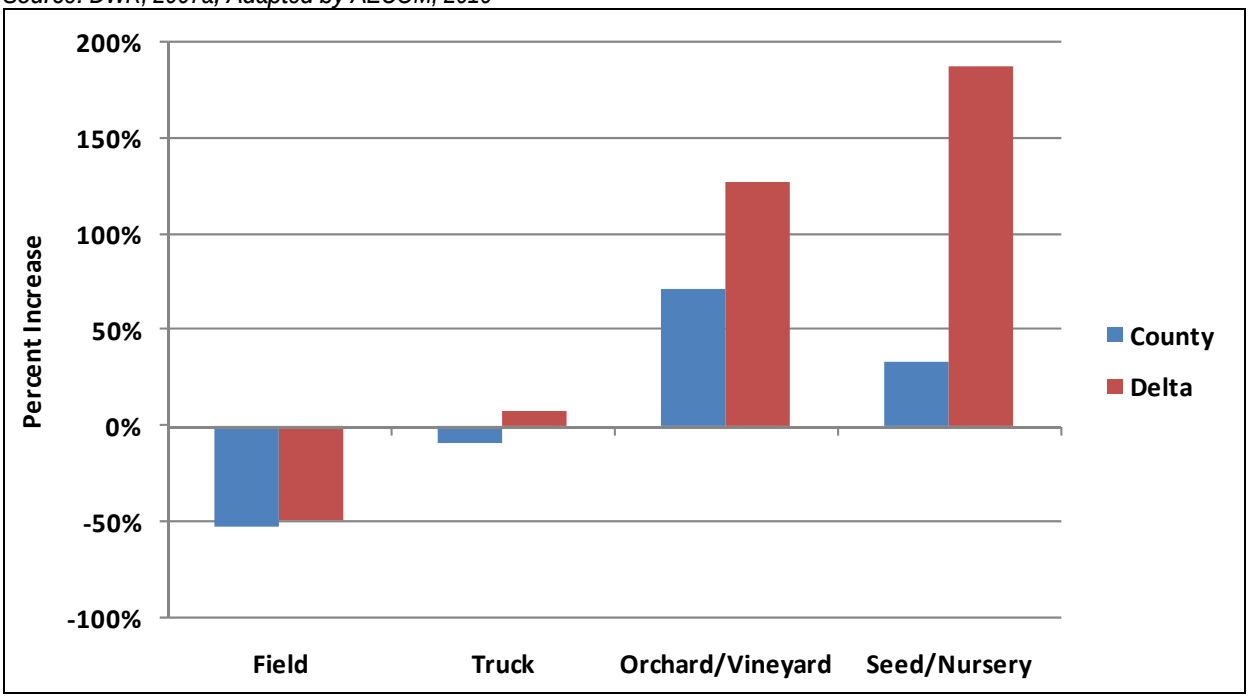


Figure 4-7
Crop Mix in the Delta versus the Five-county Region (1998–2004 Average)
Source: DWR, 2007a; Adapted by, AECOM 2010

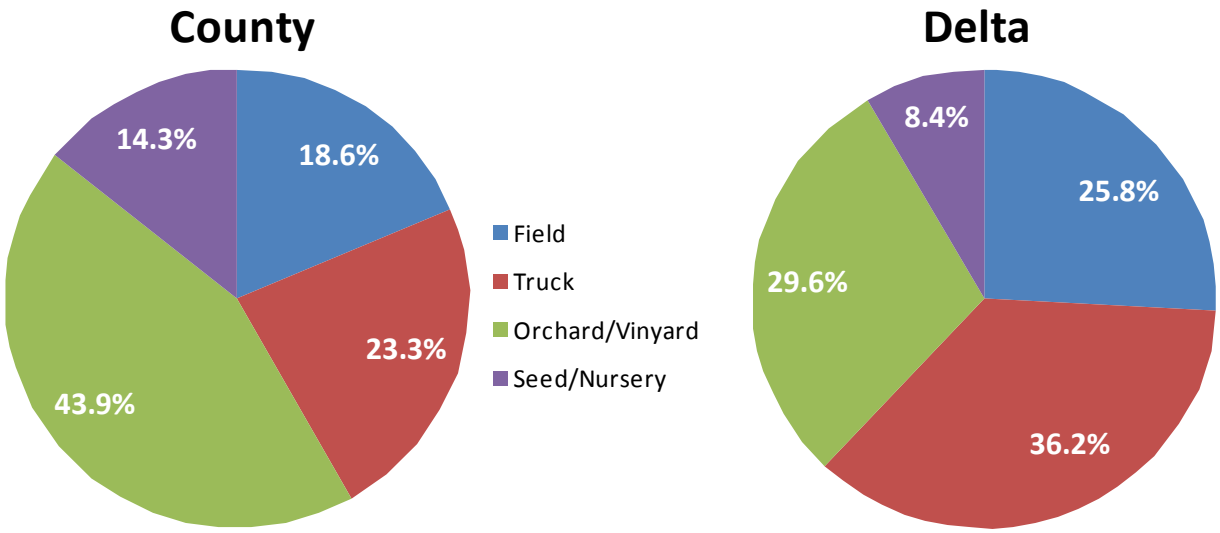


Table 4-4
Crop Mix: Delta Portions of the Counties versus the Entire Counties

Crop Group/ County	Contra Costa	Sacramento	San Joaquin	Solano	Yolo	Total	Change
1985 Delta Crop Revenue Mix							
Field	24.8%	45.5%	51.1%	70.7%	51.2%	50.5%	
Truck	51.1%	12.6%	38.7%	22.0%	38.5%	33.6%	
Orchard/Vineyard	20.9%	40.9%	6.7%	5.4%	6.5%	13.0%	
Seed/Nursery	3.2%	1.0%	3.5%	2.0%	3.8%	2.9%	
1998–2004 Average Delta Crop Revenue Mix							
Field	16.9%	21.8%	27.4%	34.5%	26.0%	25.8%	-49.0%
Truck	42.3%	14.4%	50.4%	13.8%	11.2%	36.2%	7.9%
Orchard/Vineyard	24.9%	52.5%	16.5%	27.5%	59.1%	29.6%	127.8%
Seed/Nursery	15.9%	11.2%	5.7%	24.1%	3.7%	8.4%	187.5%
1985 Total County Crop Revenue Mix							
Field	16.7%	47.6%	32.4%	53.5%	47.3%	38.3%	
Truck	30.8%	9.9%	24.6%	25.2%	37.6%	25.4%	
Orchard/Vineyard	14.0%	22.6%	38.1%	10.4%	10.6%	25.6%	
Seed/Nursery	38.6%	19.9%	4.9%	10.8%	4.5%	10.7%	
1998–2004 Average Total County Crop Revenue Mix							
Field	9.5%	20.2%	13.5%	31.1%	33.2%	18.6%	-51.6%
Truck	24.9%	12.2%	23.0%	23.6%	34.1%	23.3%	-8.4%
Orchard/Vineyard	21.6%	53.5%	53.1%	17.0%	23.9%	43.9%	71.6%
Seed/Nursery	44.0%	14.1%	10.4%	28.3%	8.7%	14.3%	33.8%

Source: DWR, 2007a

What is not captured in Table 4-2, but has been observed through other studies, is the productivity of the Delta land itself. As observed by CDFA, "virtually every one of the crops from this diverse Delta agricultural palette, from field crops to blueberries, produces greater yields and fetches higher per unit prices than do most other growing regions of these crops in the state" (California Department of Food and Agriculture, 2008). This is discussed in more detail in the next section.

Within that 2007 study, DWR made the following observations about the crop mix found within the Delta over time in comparison to the six-county region (DWR, 2007a):

> …higher-valued truck, tree, vine, nursery, and seed crops were relatively more common outside the Delta in the six-county area during the 1998–2004 period than they were inside the Delta. For the entire [five][7]-county region which includes the Delta, these higher-valued crops accounted for81.4 percent of the total gross crop revenue, versus just 74.2 percent for the Delta.
>
> Note also that the mix within the higher-valued category differs between the Delta and the entire [five][3]-county region. Annual truck crops accounted for 36 percent of the Delta's gross crop revenue from 1998–2004, versus just 23 percent for the entire [five][3]-county region. Perennial tree and vine crops accounted for just 30 percent of the

[7] Because of its minor contribution to Delta farmland and to maintain consistency, Alameda is not referenced in this paper.

Delta's gross crop revenue during the 1998–2004 period, versus 44 percent for the [five][3]-county region.

These results are just what would be expected, given the flood threats which exist in the Delta, and especially in the inner Delta. Growers would be less likely to place high-value, established orchards and vineyards at risk from flooding, than they would low-value field crops, or high value, but annual, truck crops. The flood risk factor, plus the remoteness of many Delta locations from agricultural processing, storing, transportation, and marketing facilities, also explains why the proportion of gross crop revenue from lower-valued field crops is significantly greater in the Delta than outside the Delta in the [five][3]-county region.

…the shift out of lower-valued field crops into higher-valued truck, tree, vine, nursery, and seed crops occurred at a slightly faster rate between 1985 and the 1998–2004 period outside the Delta in the [five][2]-county area than inside the Delta.

Agricultural Exports

In 2008, California's agricultural exports reached an all-time high of $12.9 billion, a 16 percent increase from 2007, and nearly a third of the Delta's agricultural value (UC Davis, 2010). For every billion dollars in agricultural exports, 27,000 jobs are created; and each dollar of exports generates $1.70 in economic activity (Norton, 2001). Table 4-5 shows the top 55 agricultural commodities exported from California. Delta agriculture contributes to 41 out of the 55 top-value crop exports in California. Most of these crops (such as rice and pears) or resulting products (such as wine and processed tomatoes) have greatly increased in value in the last several years.

Table 4-5
California Agricultural Product Export Values and Rankings, 2006–2008

2008 Rank	Product	Export Value ($ millions)			Percent Change 2007-2008	Present in Delta (2007)
		2006	2007	2008		
1	Almonds	1,899	1,879	1,899	1	Yes
2	Dairy and products	604	963	1,211	26	Yes
3	Wine	735	816	877	7	Yes
4	Table grapes	499	553	612	11	Yes
5	Pistachios	287	364	581	60	Yes
6	Rice	268	313	512	63	Yes
7	Walnuts	365	444	491	11	Yes
8	Tomatoes, processed	287	300	489	63	Yes
9	Oranges and products	359	260	422	62	Yes
10	Strawberries	274	298	338	14	Yes
11	Lettuce	244	274	315	15	Yes
12	Raisins	206	213	300	41	NA
13	Cotton	584	523	266	-49	Yes
14	Beef and products	152	199	228	14	Yes
15	Peaches and nectarines	125	147	185	26	Yes
16	Prunes	133	175	179	2	Yes
17	Lemons	104	167	172	3	No
18	Cherries	38	97	140	45	Yes

Table 4-5
California Agricultural Product Export Values and Rankings, 2006–2008

2008 Rank	Product	Export Value ($ millions) 2006	2007	2008	Percent Change 2007-2008	Present in Delta (2007)
19	Hay	125	129	133	3	Yes
20	Broccoli	112	118	120	2	Yes
21	Carrots	87	100	109	8	Yes
22	Raspberries	40	62	80	30	No
23	Plums	61	51	71	38	Yes
24	Tomatoes, fresh	62	74	70	-5	Yes
25	Celery	55	63	63	1	Yes
26	Flowers and nursery	51	59	61	4	Yes
27	Cauliflower	47	50	59	17	No
28	Potatoes	42	42	51	24	Yes
29	Wheat	14	27	49	78	Yes
30	Grape juice	28	32	48	50	NA
31	Melons	42	43	48	9	Yes
32	Onions	44	51	47	-9	Yes
33	Spinach	26	29	37	25	Yes
34	Apples	27	31	33	7	Yes
35	Pears	29	22	30	39	Yes
36	Tangerines and mandarins	15	11	29	159	No
37	Bell and chili peppers	22	22	27	19	Yes
38	Garlic	26	25	25	0	Yes
39	Turkey	18	21	25	18	NA
40	Cottonseed byproducts	12	19	22	13	NA
41	Apricots	13	16	21	30	Yes
42	Grapefruit	88	79	21	-74	Yes
43	Dates	16	18	20	11	No
44	Olives	16	17	19	11	Yes
45	Sweet potatoes	13	12	16	34	No
46	Figs	14	11	15	35	Yes
47	Cabbage	19	14	15	5	Yes
48	Kiwi	17	14	13	-7	Yes
49	Asparagus	12	16	11	-31	Yes
50	Chickens	7	9	10	13	Yes
51	Avocados	11	4	10	170	No
52	Dry beans	14	12	8	-31	Yes
53	Mushrooms	2	4	4	3	No
54	Eggs	9	9	4	-53	NA
55	Artichokes	5	4	3	-5	No

Source: UC Davis, 2010; DWR, 2008

NA = Detailed information on this commodity was not available in the source consulted.

Of the top five crops grown in the Delta—asparagus, tomatoes, corn, grapes, and alfalfa—corn alone is not on the list of top exports. It is likely that much of the corn is used locally for feed or goes towards domestic ethanol production. Asparagus has decreased in its importance in the Delta. As is shown in Table 4-5, this is a statewide trend. Asparagus lost 31 percent of its export value between 2007 and 2008. As a whole, the nation is a net importer of asparagus, with 98 percent of the crop coming from Peru or Mexico (Boriss and Brunke, 2010).

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Section 5
Agriculture and Ecosystem Health

This section summarizes current information and research, discussing the relationship between agriculture and the Delta ecosystem. Approximately three-quarters of the Delta is used for agriculture. The remaining quarter is either developed for urban uses, open water, or grassland. Other managed and natural habitats, such as managed wetlands, riparian forest and scrub, freshwater tidal marsh, vernal pool complexes, and open water, today make up less than 10 percent of the Delta (DWR, 2007b). The extent and intensity of agricultural development over the past century has irreversibly changed the natural ecosystem. These changes not only affect the species that live there, but also water quality, agricultural productivity, healthy commercial and sport fisheries, flood protection, and recreation.

The biodiversity of plant and animal species has shifted considerably over the past 150 years, although the different types of natural habitats present in the mid-nineteenth century are still present today. Currently, the Delta supports over 500 species of wildlife and over 90 different crop varieties in an average year. Of these, introduced (nonnative) species have significantly and irrevocably altered the ecology of the Delta; recent reports show 193 introduced species (69 plants, 89 invertebrates, and 35 vertebrates) now dominate most habitats within the Delta-Suisun. Invasive species can be troublesome for agricultural operations and detrimental to native habitats.

The Delta ecosystem is on a trajectory of change that cannot be completely reversed but can, at best, be managed. Generally, factors that stress ecosystems are loss of physical habitat, loss of habitat connectivity, introduction of invasive species, contamination and reductions in water quality, pesticide use, and nutrient loading. Water diversions, entrainment and stranding, and predation by nonnative invasive species also affect fish and other aquatic organisms. Some native species have adapted to using agricultural lands as habitat in place of historically abundant tidal marshes, grasslands, and seasonal wetlands. For many native wildlife and plant species, agricultural lands do not provide suitable habitat. In addition, normal agricultural operations often involve many of the other activities that can act as stressors on ecosystems; for example, runoff from normal harvest activities can result in sedimentation of water ways, contamination, and nutrient loading.

Less intensive agricultural production is more compatible with habitat.

More intensive cultivation is needed for orchards, vineyards, and confined animal production.

Less intensive cultivation is needed for seasonal and nonpermanent crops (small grains, field crops, truck crops, and forage crops).

After levees were built around Delta islands to cultivate them for agriculture, a widespread process of land subsidence began, mostly as the result of oxidation of peat soils, but also as the result of wind erosion. Some locations in the Delta are more than 20 feet below sea level. Subsidence has made levees more vulnerable to failure. Effects of levee failure and flooding on aquatic and terrestrial species are complex and depend on the location and type of islands that are flooded. Any large-scale levee failures would cause substantial losses of available habitat, food shortages for some species, and displacement of birds and other species.

Agricultural runoff from pesticides and fertilizers has historically been one of the main sources of water and soil contamination in the Delta (The Bay Institute, 1998). Pesticides from agricultural runoff can be acutely toxic and can result in impaired growth, reproduction, behavior, or increases in susceptibility to disease for fish and invertebrates (Nobriga, 2008; Werner et al., 2008).

Reducing inflow of agricultural and urban pollutants is one of the ten key ways to increase habitat variability and complexity in the Delta and Suisun Marsh.
(Moyle et al., 2010)

Although fertilizer runoff from agricultural areas can be toxic to fish and other aquatic organisms, even at very low concentrations, impacts from fertilizers in runoff is primarily due stimulatory effects on phytoplankton/aquatic plant growth (USEPA, 1999). Agricultural runoff can include a host of other toxic elements such as copper, lead, and zinc that are then released into the food chain. For example, exotic clams are highly efficient accumulators of selenium. Species that feed on these clams (such as bottom-feeding waterfowl, Sacramento splittail, salmon, and sturgeon) are particularly susceptible to selenium toxicity, as are their predators (Werner et al., 2008; Luoma et al., 2008). The most toxic and persistent pesticides (for example, DDT) have since been banned, reducing the extent of these effects, but newer pesticides and fertilizers continue to be sources of water and soil contamination in the Delta.

Some agricultural practices, depending on the crop types, growing method, level of pesticide use, and other variables may cause agriculture to be a land use as intensive as industry. The compatibility of farmland with wildlife habitat is directly related to the intensity of cultivation and chemical applications. For example, orchards, vineyards, and confined animal production facilities typically have more intensive chemical application and agricultural waste than other agriculture. Seasonal or nonpermanent crops such

as small grains (wheat and barley), field crops (corn, sorghum, and safflower), truck crops (tomatoes and sugar beets), and forage crops (hay and alfalfa) have lower or seasonally related impacts and generally are more compatible with wildlife uses. The distribution and types of seasonal crops varies annually, depending on crop-rotation patterns and market forces, and this flexibility provides opportunities for integrated wildlife habitat.

Certain synergies between agriculture and wildlife habitat provide valuable ecological services in the Delta. Several types of agriculture, including alfalfa, pasture, and rice provide especially valuable wildlife habitat. Irrigated pastures, row crops, and silage fields provide habitat for small mammals, such as western harvest mouse and California vole, ground-nesting birds, and burrowing animals; these species in turn attract predators such as Swainson's hawk, other raptors, and coyote. Giant garter snake, a state and federally listed species, uses agricultural wetlands (such as rice fields), and agricultural irrigation and drainage canals for foraging habitat and dispersal, in addition to its remaining natural habitats. Many growers leave areas of their fields in wetland or riparian habitat for benefit of wildlife (Trott, 2007).Crop types that are not tilled or disturbed are preferable as wildlife habitat. Alfalfa, which does not require frequent tilling, can support large populations of small mammals (such as voles) and invertebrate species. Alfalfa can be particularly important as foraging habitat to Swainson's hawk, white-tailed kite, and other raptor species that capitalize on high prey densities and cycles of increased prey availability when the fields are being irrigated and mowed. The drawback to active agricultural fields is that entire colonies are susceptible to destruction when crops are harvested (Solano County, 2008).

Flood-irrigated crops such as rice can support a range of wildlife. Rice is usually grown in areas that previously supported natural wetlands, and many wetland-associated wildlife species use rice fields, especially waterfowl and shorebirds. Waste grain also provides food for species such as ring-necked pheasant and greater sandhill crane. Other wildlife species that use rice fields include giant garter snake, and wading birds that forage on aquatic invertebrates and small vertebrates. In particular, the practice of flooding rice fields in winter to allow rice stubble to rot, instead of burning rice stubble in fall, provides a wide variety of ducks and geese opportunities to loaf or forage in rice fields in winter.

Grain and seed crops, such as corn, wheat, and barley, are annual grasses that are grown in dense stands that make it difficult for wildlife to move through the fields; most of wildlife benefits are derived early in the growing period, and especially following the harvest, when waste grain is accessible to waterfowl and other birds such as sandhill cranes.

The greater sandhill crane, a state-listed threatened and "fully protected" species, is a prime example of how agricultural areas can provide viable habitat for some imperiled wildlife. Following conversion of tidal marshes to agricultural fields, cranes shifted their foraging habitat to agricultural fields (such as corn), while often using managed wetlands as roosting habitat. Currently, the Delta provides approximately two-thirds of the wintering habitat of the California population of greater sandhill crane (Pogson and Lindstedt, 1988; Littlefield and Ivey, 2000).), which is probably a larger fraction than it was historically. The Central Valley population of the greater sandhill crane spends the winter foraging primarily in harvested corn, along with winter wheat, alfalfa, pasture, and fallow fields; congregating along agricultural field borders, levees, rice checks, or ditches, or in alfalfa fields or pastures; and roosting in shallowly flooded open fields or wetlands interspersed with uplands (Pogson and Lindstedt, 1988). Roost sites, which provide protection from predators during the night, are typically within 2 to 3 miles of foraging and loafing areas; and, thus, available roosting sites are an essential

Integrated management of agriculture and wildlife habitat is increasingly common in the Delta.

Integrated techniques include soil-building crops, fallowing, pest management (to reduce chemical use) cover crops, permanent pasture, and conservation tillage.

component of winter habitat. Greater sandhill cranes have a strong affinity with roost locations and only use certain areas in the central Delta; thus, agricultural lands only provide habitat for this species in the vicinity of these roost sites. Threats to the wintering grounds of the greater sandhill crane include changes in water availability; flooding of fields for waterfowl, which reduces foraging habitat for cranes; conversion of cereal cropland to vineyards or other incompatible crop types; human disturbances; collision with power lines and other structures; disease; and urban encroachment (Littlefield and Ivey, 2000).

Examples of integrated management of agriculture and wildlife habitat in the Delta are becoming more common. These management techniques include crop rotations that include soil-building crops or fallowing; integrated pest management to reduce pesticides; cover crops; the strategic use of permanent crops, such as pasture, to reduce soil disturbance and oxidation; and a form of conservation tillage for field and row crops that reduces energy inputs, lessens soil disturbance and oxidation, and minimizes soil compaction by reducing farm machinery passes (Trott, 2007). Farmers on Staten Island grow grains in a manner that supports populations of sandhill cranes and other migratory birds, and much of the Yolo Bypass is farmed even as it stands ready to divert floodwaters from the Sacramento River (Governor's Delta Vision Blue Ribbon Task Force, 2008).

Preliminary results from DWR and U.S. Geological Survey experiments indicate that wetland agricultural uses could dramatically slow, stop, or reverse peat oxidation and island subsidence. By growing four potential crops – rice, fish, fish food, and carbon (that is, growing wetland vegetation to sequester carbon dioxide in return for carbon credit payments as part of a carbon "cap and trade" program being considered by the Governor's Climate Action Team pursuant to Assembly Bill 32 [2006]) – they have demonstrated that Delta island subsidence can be stopped or reversed (Trott, 2007).

American Farmland Trust, as a part of their Agriculture and Environment Initiative, has a Best Management Practices Challenge and Ecosystem Services Market Program that provides economic assurance to farmers that reduce pesticide use and tillage, and helps them integrate environmental services into their farming practices. These programs are supported in part by federal funding from USEPA. In addition, similar programs such as the Federal Environmental Quality Incentives Program administered by the U.S. Department of Agriculture, Natural Resources Conservation Service, and DWR Flood Corridor grant program offer financial incentives for farmers to grow and manage habitat.

Section 6
Future Risks and Policy Issues

The Delta's economy and way of life is currently dependent on agriculture. Factors diminishing the Delta's ability to function as both a healthy ecosystem and economic place will threaten it capacity to accommodate both wildlife and people. This identification of potential future risks was drawn heavily from information contained in the 2009 California Climate Adaptation Strategy (California Natural Resources Agency), the LRMP (DPC, 2010a), the *Delta Protection Commission 2006 – 2011 Strategic Plan* (DPC, 2006), and Delta Plan white papers that address ecosystem and flood risks.

Future Risks

Several trends will affect overall ecosystem health in the Delta and the continued viability of the agriculture. Potential risks arise from a combination of natural and human forces that may impact the

Delta's economy and the communities that depend on the Delta's natural resources and agriculture. These threats include the following:

- Urbanization and development pressure;
- Subsidence and loss of agricultural lands;
- Levee failure, flood inundation;
- Climate change – sea level rise, temperature, climate variability, and storm frequency and intensity;
- Increasing soil salinity; and
- Change in water quality and supply

As described previously, although the acres of land devoted to agriculture decreased in the past 20 years, the overall value of Delta crops increased. Fluctuations in state, national, and global markets will continue to impact the economic viability of agriculture in the Delta.

Urbanization

Urban development affects agriculture through the loss of farmland to urban development; encroachment of nonagricultural uses near agricultural operations; harassment or lawsuits due to nuisance claims; loss of agricultural water supply for urban use; increased urban use of agricultural roads and infrastructure; demand for new urban infrastructure; and the parceling of agricultural land and conversion to rural residential estates. Trends that impact the viability of agriculture also adversely affect farm employment, businesses, utilities, and tax-funded entities that form the basis of the agricultural economy.

Urbanization and development of agricultural areas is affected by local planning policies that do not limit areas for future urban growth or allow the subdivision of parcels within agricultural areas without a corresponding commitment that the land will still be farmed. Minimum farmable parcel size depends on soil productivity and the value of agricultural produce. Parcel size alone does not determine whether a property will be farmed (land values, market conditions, and other factors also come into play). It becomes increasingly difficult to maintain viable commercial farming operations when land is divided into ever smaller parcels.

All of the Delta counties have experienced significant parceling of agricultural lands and increasing rural residential development, replacing agricultural uses and encroaching into agricultural areas. Policies that could positively affect agricultural viability include requiring that subdivided lands be limited to agriculturally oriented land uses, providing adequate buffers between agricultural and nonagricultural land uses, promoting "right-to-farm" ordinances, and encouraging the use of conservation easements.

Subsidence

Subsidence of agricultural lands, particularly on Delta islands, is a growing threat to the viability of agriculture. Many levees currently protect subsiding Delta islands from flooding. As islands continue to subside, risks for levee failure increase, resulting in an increased risk of flooding. The costs to recover a flooded island could be great. The Delta's levee system continues to decline due to failing levee integrity and subsidence. This decline not only affects the levees but the entire Delta economy, ecosystem, way of life, and communities in the Delta. Preliminary results from DWR and U.S. Geological Survey experiments indicate that wetland agricultural uses could dramatically slow, stop, or reverse peat oxidation and island subsidence. Permanently flooded wetlands reduce or stop emissions of carbon (carbon dioxide) from the soil, which reverses subsidence and decreases greenhouse gas emissions (Fujii et al., 2007). In a recent experiment, U.S. Geological Survey scientists succeeded in building up to 2 feet of peat soil on previously drained terrain (Wilson, 2008).

Levee Failure

Levee failure will be a greater risk because of sea level rise resulting from predicted climate changes, which could intensify storms, leading to greater probability flooding and inundation of Delta lands. This risk is expected to intensify with time. Continued levee improvements to maintain agricultural lands and fixed channels will reduce the Delta's natural ability to adapt to a rising sea level and changing flooding patterns. An increased flooding potential exists upstream, affecting agricultural lands both within and outside the Delta.

Climate Change

California's agriculture could be affected by the warming projected by the latest climate change models used by the California Natural Resources Agency. Some crop yields may increase with warming, and others may decrease. According to these models, many of today's top annual field crops, such as wheat, cotton, maize, sunflower, and rice, show declining yields later in the century due to rising temperatures. Conversely, the production of high-quality wine grapes is expected to benefit from a warmer climate because of a longer growing season and more favorable growing conditions in the short term. At some point, however, the magnitude of the warming may become too large for certain grape varieties.

Although agriculture may benefit from higher levels of atmospheric carbon dioxide (which functions as a fertilizer and increases the efficiency of the plants' water use) and a lengthening of the growing season, these temperature changes may also lead to an increase in undesirable pests. Weeds and other invasive species are likely to migrate north because of temperature increases, and disease and pest pressures will increase with earlier spring arrival and warmer winters. In addition, crop-pollinator timing can also be affected by climate change, leading to a need for modifications in crop production. If the industries and infrastructure that support Delta agriculture are threatened, then, by extension, agriculture is threatened.

Soil Salinity

Long-term impacts from intense agricultural use are becoming more apparent and persistent in the Delta ecosystem. For the first 50 years of agriculture in the Delta, excess salt was not a problem. Since then, salt accumulation has become progressively unbalanced. Unless addressed, accumulation of salt in soil and groundwater will be a major threat to agricultural productivity and ecosystem health (Howitt, 1995). Maintenance of current water quality standards could require the release of more fresh water upstream from reservoirs to flush excess salt from the Delta, resulting in less for agricultural and urban users.

Water Quality

Agricultural runoff from pesticides and fertilizers is one of the main sources of water and soil contamination in the Delta (The Bay Institute, 1998). The most toxic and persistent pesticides (for example, DDT) have since been banned, reducing the extent of these effects, but newer pesticides and fertilizers continue to be sources of water and soil contamination in the Delta. Agricultural operations can be improved further through best management techniques that increase benefits to wildlife and the ecosystem.

Integrated management of agriculture and wildlife habitat in the Delta is becoming more common. Best management techniques include crop rotations that include soil-building crops or fallowing; integrated pest management to reduce pesticides; cover crops; the strategic use of permanent crops, such as pasture, to reduce soil disturbance and oxidation; and a form of conservation tillage for field and row crops that reduces energy inputs, lessens soil disturbance and oxidation, and minimizes soil compaction by reducing farm machinery passes (Trott, 2007).

The Central Valley Regional Water Quality Control Board initiated the Irrigated Lands Regulatory Program with the adoption of Conditional Waiver of Waste Discharge Requirements. The 2003 Conditional Waiver expired in 2006, and a Revised Conditional Waiver was adopted that continues until June 2011. This program was designed to maintain or restore the quality of water, minimize waste discharge from agricultural land, maintain economic viability of agriculture in the Central Valley, and ensure that irrigated agricultural waste discharge will not adversely affect drinking water supplies. Farmers and ranchers were encouraged to join a coalition to manage and monitor water quality, supporting the use of alternative methods in operations that prevent fertilizers and pesticides from reaching streams.

Water Supply

Water supply is affected by the availability of groundwater and surface water, and the quality of water for various uses such as irrigation or drinking. Degradation in the water quality, as mentioned previously, can affect how the water available can serve the agricultural area. Increasing salinity in the water reduces the water supply readily available for beneficial uses. As urban development increases throughout the state, the demand for water, as well as reduction in supply caused by drought, has lead to cuts in surface water supplies to Delta farmers. Many farmers have drilled new or deeper wells to reach a rapidly increasing problem with overdraft of San Joaquin Valley aquifers. In addition, “an increasing reliance on groundwater also means the addition of more salts to farmland, and land subsidence” (California Department of Food and Agriculture, 2008).

Policy Issues

The issues that threaten the Delta provide a framework for what policies should be considered. As described by the California Farm Bureau Federation, agriculture is only sustainable when it is profitable,; and sustainable agriculture should be “an integrated system of plant and animal production practices … that will enhance the economic viability of agricultural operations” to not only “satisfy human food and fiber needs,” but also “promote environmental quality and the natural resources base upon which the agricultural economy depends” (California Farm Bureau Federation, 2010). This has a direct correlation to the policy issues facing the Delta today. These policy issues include the following:

- Regulating uses on subdivided lands, providing adequate buffers between agricultural and nonagricultural land uses, promoting “right-to-farm” ordinances, and encouraging the use of conservation easements;
- Encouraging carbon sequestration and growing crops that help to prevent or reverse peat oxidation;
- Continuing levee improvements;
- Understanding the potential positive or negative effects of climate change, and working with agriculture and related industries on adaption techniques;
- Releasing more upstream fresh water to flush excess salt and other contaminants; and
- Promoting best management techniques, including crop rotations, integrated pest management, cover crops, the strategic use of permanent crops, and a form of conservation tillage for field and row crops.

The decisions regarding these policy issues will greatly influence the continued viability of Delta agriculture and guide how well the Delta may provide for the varied economic, ecologic, and social services found in the Delta today.

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Appendix A
Selected LURMP Agriculture and Land Use Policies

Agriculture

P-5. Local governments shall encourage implementation of the necessary plans and ordinances to: maximize agricultural parcel size; reduce subdivision of agricultural lands; protect agriculture and related activities; protect agricultural land from conversion to non-agriculturally-oriented uses. An optimum package of regulatory and incentive programs could include: (1) an urban limit line; (2) minimum parcel size consistent with local agricultural practices and needs; (3) strict subdivision regulations regarding subdivision of agricultural lands to ensure that subdivided lands will continue to contain agriculturally oriented land uses; (4) require adequate buffers between agricultural and non-agricultural land uses particularly residential development outside but adjacent to the Primary Zone; (5) an agriculture element of the general plan; (6) a Right-to-Farm ordinance; and (7) a conservation easement program.

Land Use

P-3. New non-agriculturally oriented residential, recreational, commercial, habitat, restoration, or industrial development shall ensure that appropriate buffer areas are provided by those proposing new development to prevent conflicts between any proposed use and existing adjacent agricultural parcels. Buffers shall adequately protect integrity of land for existing and future agricultural uses and shall not include uses that conflict with agricultural operations on adjacent agricultural lands. Appropriate buffer setbacks shall be determined in consultation with local Agricultural Commissioners, and shall be based on applicable general plan policies and criteria included in Right-to-Farm Ordinances adopted by local jurisdictions.

P-4. Direct new non-agriculturally oriented non-farmworker residential development within the existing unincorporated towns (Walnut Grove, Clarksburg, Courtland, Hood, Locke, and Ryde).

P-11. Local governments may develop programs to cluster residential units that allow property owners to engage in limited property development in order to ensure the efficient use and conservation of agricultural lands, support open space values, and protect sensitive environmental areas in the Primary Zone. Clustered development occurs when contiguous or non-contiguous parcels are developed to cluster lots for residential use. The purpose of clustered development is to provide a mechanism to preserve

agricultural land and open space, to locate housing in areas that can readily be served by public services and utilities, and provide the agricultural community an alternative to transfer of development rights. Clustered development programs shall ensure that the number of clustered lots created does not exceed the allowable density requirement for the zoning of the sum of the parcels. Clustered development may only be used one time. Neither the clustered lots nor the remainder lots may be further subdivided. Residential development shall be consistent with local General Plan policies and zoning regulations and standards.

Appendix B
Farmland Definitions

Prime Farmland

Prime Farmland is land which has the best combination of physical and chemical characteristics for the production of crops. It has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops when treated and managed, including water management, according to current farming methods. Prime Farmland must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date. It does not include publicly owned lands for which there is an adopted policy preventing agricultural use.

Prime Farmland must meet all of the following criteria:

a. Water

The soils have xeric, ustic, or aridic (torric) moisture regimes in which the available water capacity is at least 4.0 inches (10 cm) per 40 to 60 inches (1.02 to 1.52 meters) of soil, and a developed irrigation water supply that is dependable and of adequate quality. A dependable water supply is one that is available for the production of the commonly grown crops in 8 out of 10 years; and

b. Soil Temperature Range

The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These are soils that, at a depth of 20 inches (50.8 cm), have a mean annual temperature higher than 32°F (0°C). In addition, the mean summer temperature at this depth in soils with an O horizon is higher than 47°F (8°C); in soils that have no O horizon, the mean summer temperature is higher than 59°F (15°C); and

c. Acid-Alkali Balance

The soils have a pH between 4.5 and 8.4 in all horizons within a depth of 40 inches (1.02 meters); and

d. Water Table

The soils have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown; and

e. Soil Sodium Content

The soils can be managed so that, in all horizons within a depth of 40 inches (1.02 meters), during part of each year the conductivity of the saturation extract is less than 4 mmhos/cm and the exchangeable sodium percentage is less than 15; and

f. Flooding

Flooding of the soil (uncontrolled runoff from natural precipitation) during the growing season occurs infrequently, taking place less often than once every 2 years; and

g. Erodibility

The product of K (erodibility factor) multiplied by the percent of slope is less than 2.0; and

h. Permeability

The soils have a permeability rate of at least 0.06 inch (0.15 cm) per hour in the upper 20 inches (50.8 cm), and the mean annual soil temperature at a depth of 20 inches (50.8 cm) is less than 59°F (15°C); the permeability rate is not a limiting factor if the mean annual soil temperature is 59°F (15°C) or higher; and

i. Rock Fragment Content

Less than 10 percent of the upper 6 inches (15.24 cm) in these soils consists of rock fragments coarser than 3 inches (7.62 cm); and

j. Rooting depth

The soils have a minimum rooting depth of 40 inches (1.02 meters).

Farmland of Statewide Importance

Farmland of Statewide Importance is land other than Prime Farmland that has a good combination of physical and chemical characteristics for the production of crops. It must have been used for the production of irrigated crops at some time during the two update cycles prior to the mapping date. It does not include publicly owned lands for which there is an adopted policy preventing agricultural use.

Farmland of Statewide Importance must meet all of the following criteria:

a. Water

The soils have xeric, ustic, or aridic (torric) moisture regimes in which the available water capacity is at least 3.5 inches (8.89 cm) within a depth of 60 inches (1.52 meters) of soil; or within the root zone if it is less than 60 inches (1.52 meters) deep. They have a developed irrigation supply that is dependable and of adequate quality. A dependable water supply is one that is available for the production of the commonly grown crops in 8 out of 10 years; and

b. Soil Temperature Range

The soils have a temperature regime that is frigid, mesic, thermic, or hyperthermic (pergelic and cryic regimes are excluded). These are soils that, at a depth of 20 inches (50.8 cm), have a mean annual temperature higher than 32°F (0°C). In addition, the mean summer temperature at this depth in soils with an O horizon is higher than 47°F (8°C); in soils that have no O horizon, the mean summer temperature is higher than 59°F (15°C); and

c. Acid-Alkali Balance

The soils have a pH between 4.5 and 9.0 in all horizons within a depth of 40 inches (1.02 meters) or in the root zone if the root zone is less than 40 inches (1.02 meters) deep; and

d. Water Table

The soils have no water table or have a water table that is maintained at a sufficient depth during the cropping season to allow cultivated crops common to the area to be grown; and

e. Soil Sodium Content

The soils can be managed so that, in all horizons within a depth of 40 inches (1.02 meters), or in the root zone if the root zone is less than 40 inches (1.02 meters) deep, during part of each year the conductivity of the saturation extract is less than 16 mmhos/cm and the exchangeable sodium percentage is less than 25; and

f. Flooding

Flooding of the soil (uncontrolled runoff from natural precipitation) during the growing season occurs infrequently, taking place less often than once every 2 years; and

g. Erodibility

The product of K (erodibility factor) multiplied by the percent of slope is less than 3.0; and

h. Rock Fragment Content

Less than 10 percent of the upper 6 inches (15.24 cm) in these soils consists of rock fragments coarser than 3 inches (7.62 cm).

Farmland of Statewide Importance does not have any restrictions regarding permeability or rooting depth.

Unique Farmland

Unique Farmland is land that does not meet the criteria for Prime Farmland or Farmland of Statewide Importance and has been used for the production of specific high economic-value crops at some time during the two update cycles prior to the mapping date. It has the special combination of soil quality, location, growing season, and moisture supply needed to produce sustained high quality and/or high yields of a specific crop when treated and managed according to current farming methods. Examples of such crops may include oranges, olives, avocados, rice, grapes, and cut flowers. It does not include publicly owned lands for which there is an adopted policy preventing agricultural use.

The following are characteristics of Unique Farmland:

a. Is used for specific high-value crops; and

b. Has a moisture supply that is adequate for the specific crop; the supply is from stored moisture, precipitation, or a developed irrigation system; and

c. Combines favorable factors of soil quality, growing season, temperature, humidity, air drainage, elevation, exposure, or other conditions, such as nearness to market, that favor growth of a specific food or fiber crop; and

d. Excludes abandoned orchards or vineyards, dryland grains, and extremely low-yielding crops, such as irrigated pasture, as determined in consultation with the County Cooperative Extension Director and Agricultural Commissioner.

High-value crops are listed in California Agriculture, an annual report of the California Department of Food and Agriculture. In order for land to be classified Unique Farmland, the crop grown on the land must have qualified for the list at some time during the two update cycles prior to the mapping date.

Farmland of Local Importance

Farmland of Local Importance is either currently producing crops, has the capability of production, or is used for the production of confined livestock. Farmland of Local Importance is land other than Prime Farmland, Farmland of Statewide Importance, or Unique Farmland. This land may be important to the local economy because of its productivity or value. It does not include publicly owned lands for which there is an adopted policy preventing agricultural use. In a few counties, the local advisory committee has elected to additionally define areas of Local Potential (LP) farmland. This land includes soils that qualify for Prime Farmland or Farmland of Statewide Importance, but generally are not cultivated or irrigated. For reporting purposes, Local Potential and Farmland of Local Importance are combined in the acreage tables.

Grazing Land

Grazing Land is defined in Government Code section 65570(b)(3) as "..land on which the existing vegetation, whether grown naturally or through management, is suitable for grazing or browsing of livestock." The minimum mapping unit for Grazing Land is 40 acres. Grazing Land does not include land previously designated as Prime Farmland, Farmland of Statewide Importance, Unique Farmland, or Farmland of Local Importance, and heavily brushed, timbered, excessively steep, or rocky lands that restrict the access and movement of livestock. The FMMP convenes a grazing land advisory committee in each project county to help identify grazing lands. The committees consist of members of the local livestock ranching community, livestock ranching organizations, and the U.C. Cooperative Extension livestock advisor. The FMMP works with the president of the local Cattlemen's Association and the U.C. Cooperative Extension livestock advisor in selecting members of these committees.

Urban and Built-Up Land

Urban and Built-Up Land is used for residential, industrial, commercial, construction, institutional, public administrative purposes, railroad yards, cemeteries, airports, golf courses, sanitary landfills, sewage treatment plants, water control structures, and other development purposes. Highways, railroads, and other transportation facilities are mapped as a part of Urban and Built-Up Land if they are a part of the surrounding urban areas.

Units of land smaller than 10 acres will be incorporated into the surrounding map classifications. The building density for residential use must be at least one structure per 1.5 acres (or approximately six structures per 10 acres). Urban and Built-Up Land must contain human-made structures or buildings under construction, and the infrastructure required for development (such as, paved roads, sewers, water, electricity, drainage, or flood control facilities) that are specifically designed to serve that land. Parking lots, storage and distribution facilities, and industrial uses such as large packing operations for agricultural produce will generally be mapped as Urban and Built-Up Land even though they may be associated with agriculture.

Urban and Built-Up Land does not include strip mines, borrow pits, gravel pits, farmsteads, ranch headquarters, commercial feedlots, greenhouses, poultry facilities, or road systems for freeway interchanges outside of areas classified as Urban and Built-Up Land areas.

Within areas classified as Urban and Built-Up Land, vacant and nonagricultural land that is surrounded on all sides by urban development and is less than 40 acres in size will be mapped as Urban and Built-Up. Vacant and nonagricultural land larger than 40 acres in size will be mapped as Other Land.

Other Land

Other Land is that which is not included in any of the other mapping categories. The following types of land are generally included:

a. Rural development that has a building density of less than one structure per 1.5 acres, but with at least one structure per 10 acres;

b. Brush, timber, wetlands, and other lands not suitable for livestock grazing;

c. Government lands not available for agricultural use;

d. Road systems for freeway interchanges outside of Urban and Built-Up Land areas;

e. Vacant and nonagricultural land larger than 40 acres in size and surrounded on all sides by urban development;

f. Confined livestock, poultry, or aquaculture facilities, unless accounted for by the county's Farmland of Local Importance definition;

g. Strip mines, borrow pits, gravel pits, and ranch headquarters, or water bodies smaller than 40 acres;

h. A variety of other rural land uses.

Land Committed to Nonagricultural Use

Land Committed to Nonagricultural Use is land that is permanently committed by local elected officials to nonagricultural development by virtue of decisions that cannot be reversed simply by a majority vote of a city council or county board of supervisors.

County boards of supervisors and city councils will have the final authority to designate lands in this category. The FMMP will work with city and county planning staffs to obtain this information. Land Committed to Nonagricultural Use will be shown on an overlay to Important and Interim Farmland Maps. The current land use will be indicated on the base map, with the overlay indicating the areas that are Committed to Nonagricultural Use. Land Committed to Nonagricultural Use must be designated in an adopted, local general plan for future nonagricultural development. The resulting development must meet the requirements of Urban and Built-Up Land or the rural development density criteria of Other Land.

Land Committed to Nonagricultural Use must also meet the requirements of either (a) or (b) below:

a. It must have received one of the following final discretionary approvals:

    1. Tentative subdivision map (approved per the Subdivision Map Act);

    2. Tentative or final parcel map (approved per the Subdivision Map Act);

    3. Recorded development agreement (per Government Code section 65864); and

    4. Other decisions by a local government that are analogous to items #1-3 above and which exhibit an element of permanence. Zoning by itself does not qualify as a permanent commitment.

Or

b. It must be the subject of one of the final fiscal commitments to finance the capital improvements specifically required for future development of the land in question as shown below:

    1. Recorded Resolution of Intent to form a district and levy an assessment;
    2. Payment of assessment;
    3. Sale of bonds;
    4. Binding contract, secured by bonds, guaranteeing installation of infrastructure; and
    5. Other fiscal commitments that are analogous to items #1-4 above and exhibit an element of permanence.

Land Committed to Nonagricultural Use is mapped when the respective local government notifies FMMP that the land meets these criteria and submits 1:24,000 maps identifying the area and showing its boundaries. The information provided is subject to verification by FMMP. In some cases, the local government must also provide FMMP with documentation of the permanent commitment.

Soil Taxonomy Terms

Soils are classified on the basis of their physical and chemical characteristics using systems outlined by the U.S. Department of Agriculture's *Soil Survey Manual* and the National Cooperative Soil Survey's *Soil Taxonomy*.

Soil **horizons** are layers of soils approximately parallel to the land surface and differing from adjacent, genetically related layers in physical, chemical, and biological properties. Examples of such properties include color, texture, acid-alkali balance, and organic matter content. Soil moisture regimes are used in defining soil classes at various levels in the soil taxonomy system, as follows:

Xeric – Typically found in Mediterranean-type climates where winters are moist and cool, and summers are warm and dry.

Ustic – Involves the concept of limited, but effective, soil moisture. Though implying dryness, moisture is available at a time when other conditions are suitable for plant growth.

Aridic (torric) – Soils with this moisture regime are generally found in arid climates with hot and dry summers. Soil temperature regimes are used in defining soil classes at a depth of 19.7 inches (50 cm or to the depth of rock if it is shallower), which is analogous to plant rooting depth.

Frigid – Mean annual soil temperature is less than 47°F (8°C), and the difference between mean winter and mean summer temperature is more than 9°F (5°C).

Mesic – Mean annual soil temperature is between 47°F (8°C) and 59°F (15°C), and the difference between mean summer and mean winter soil temperature is more than 9°F (5°C).

Thermic – Mean annual soil temperature is between 59°F (15°C) and 72°F (22°C), and the difference between mean summer and mean winter soil temperature is more than 9°F (5°C).

Hyperthermic – Mean annual soil temperature is greater than 72°F (22°C), and the difference between mean winter and mean summer temperature is more than 9°F (5°C).

Pergelic – Mean annual soil temperature is lower than 32°F (0°C). Permafrost is present.

Cryic – Mean annual temperature is higher than 32°F (0°C) but lower than 47°F (8°C), and the difference between mean summer and mean winter soil temperature is more than 9°F (5°C).

Soil salinity may be expressed in terms of the electrical conductivity of the water in contact with the soil.

mmhos/cm – A unit of electrical conductivity, which is a measure of the salinity of soil. Soil acid-alkali balance is expressed in terms of pH.

pH – A numerical measure of acidity or hydrogen ion activity. Neutral is pH 7.0. All pH values below 7.0 are acid, and all above 7.0 are alkaline.

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Appendix C
Expanded Farmland Tables

Table 3-1 (expanded)
Delta Farmland in 1984 (by County)

Farmland Type	Total Acres*	Primary Acres	Secondary Acres	Legal Delta Acres
Alameda County				
Urban and Built-Up Land	126,841	0	65	65
Grazing Land	257,238	0	1,219	1,219
Farmland of Local Importance	0	0	0	0
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	9,809	0	2,613	2,613
Farmland of Statewide Importance	1,870	0	256	256
Unique Farmland	1,190	0	73	73
Water	52,776	0	0	0
Other Land	75,615	0	419	419
Contra Costa County				
Urban and Built-Up Land	126,841	374	16,703	17,077
Grazing Land	257,238	0	888	888
Farmland of Local Importance	0	1,374	4,541	5,915
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	9,809	15,265	24,533	39,799
Farmland of Statewide Importance	1,870	6,229	9,300	15,529
Unique Farmland	1,190	2,078	5,927	8,005
Water	52,776	18,229	1,350	19,579
Other Land	75,615	2,325	3,413	5,738
Sacramento County				
Urban and Built-Up Land	131,321	438	4,875	5,313
Grazing Land	176,777	2,395	1,058	3,454
Farmland of Local Importance	31,821	1,062	799	1,861

Table 3-1 (expanded)
Delta Farmland in 1984 (by County)

Farmland Type	Total Acres*	Primary Acres	Secondary Acres	Legal Delta Acres
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	124,415	68,379	8,817	77,196
Farmland of Statewide Importance	79,822	739	3,928	4,668
Unique Farmland	12,082	5,152	1,435	6,587
Water	18,695	12,511	1,499	14,010
Other Land	61,150	4,857	520	5,377
San Joaquin County				
Urban and Built-Up Land	63,777	1,001	22,615	23,616
Grazing Land	157,874	92	387	480
Farmland of Local Importance	53,145	1,139	3,686	4,825
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	437,859	155,039	80,066	235,105
Farmland of Statewide Importance	100,277	6,731	10,149	16,880
Unique Farmland	46,863	2,906	6,074	8,980
Water	10,187	7,664	716	8,380
Other Land	42,618	13,327	5,865	19,193
Solano County				
Urban and Built-Up Land	40,171	90	4	94
Grazing Land	220,142	12,770	4,082	16,852
Farmland of Local Importance	0	0	0	0
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	152,225	51,864	0	51,864
Farmland of Statewide Importance	12,620	8,795	0	8,795
Unique Farmland	16,112	2,487	0	2,487
Water	50,612	9,392	795	10,187
Other Land	90,489	817	1,426	2,243
Yolo County				
Urban and Built-Up Land	20,855	228	4,429	4,656
Grazing Land	121,876	6,527	0	6,527
Farmland of Local Importance	91,604	5,000	1,586	6,585
Farmland of Potential Local Importance	2,721	0	16	16
Prime Farmland	272,952	34,595	4,685	39,280
Farmland of Statewide Importance	23,758	8,076	2,027	10,103
Unique Farmland	56,883	14,553	2,188	16,741
Water	6,913	2,339	1,415	3,754
Other Land	55,890	3,420	972	4,392

Source: California Farmland Mapping and Monitoring Program (FMMP), 1984

Note: All acreages rounded to nearest whole number.

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Table 3-2 (expanded)
Delta Farmland in 2008 (by County)

Farmland Type	Total Acres	Primary Acres	Secondary Acres	Legal Delta Acres
Alameda County				
Confined Animal Agriculture	0	0	0	0
Urban and Built-Up Land	146,076	0	147	147
Grazing Land	244,251	0	1,862	1,862
Farmland of Local Importance	0	0	0	0
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	3,958	0	2,073	2,073
Rural Residential Land	0	0	0	0
Farmland of Statewide Importance	1,290	0	75	75
Unique Farmland	2,442	0	99	99
Vacant or Disturbed Land	0	0	0	0
Water	53,780	0	0	0
Other Land	73,522	0	389	389
Nonagricultural or Natural Vegetation	0	0	0	0
Semi-Agricultural and Rural Commercial Land	0	0	0	0
Contra Costa County				
Confined Animal Agriculture	0	0	0	0
Urban and Built-Up Land	151,337	500	27,326	27,826
Grazing Land	168,905	201	2,007	2,208
Farmland of Local Importance	53,450	10,792	9,499	20,291
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	26,789	10,991	15,028	26,019
Rural Residential Land	0	0	0	0
Farmland of Statewide Importance	7,555	3,190	4,344	7,533
Unique Farmland	3,123	931	1,766	2,697
Vacant or Disturbed Land	0	0	0	0
Water	53,764	16,437	1,192	17,629
Other Land	49,097	2,831	5,494	8,325
Nonagricultural or Natural Vegetation	0	0	0	0
Semi-Agricultural and Rural Commercial Land	0	0	0	0
Sacramento County				
Confined Animal Agriculture	0	0	0	0
Urban and Built-Up Land	177,915	1,105	5,679	6,784
Grazing Land	156,145	2,747	194	2,941
Farmland of Local Importance	43,819	6,272	1,249	7,521
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	104,367	62,429	7,571	70,000
Rural Residential Land	0	0	0	0
Farmland of Statewide Importance	49,470	771	3,058	3,828

Table 3-2 (expanded)
Delta Farmland in 2008 (by County)

Farmland Type	Total Acres	Primary Acres	Secondary Acres	Legal Delta Acres
Unique Farmland	15,463	4,230	622	4,852
Vacant or Disturbed Land	0	0	0	0
Water	18,147	12,433	1,396	13,829
Other Land	70,757	5,547	3,164	8,711
Nonagricultural or Natural Vegetation	0	0	0	0
Semi-Agricultural and Rural Commercial Land	0	0	0	0
San Joaquin County				
Confined Animal Agriculture	5,552	201	1,343	1,544
Urban and Built-Up Land	90,530	1,176	32,834	34,010
Grazing Land	142,461	108	335	443
Farmland of Local Importance	60,236	5,250	6,335	11,585
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	396,985	149,485	65,890	215,374
Rural Residential Land	14,582	129	1,274	1,404
Farmland of Statewide Importance	86,298	6,353	7,807	14,159
Unique Farmland	66,622	3,391	6,045	9,436
Vacant or Disturbed Land	10,372	683	2,812	3,495
Water	11,773	9,029	959	9,988
Other Land	0	0	0	0
Nonagricultural or Natural Vegetation	23,140	11,205	3,213	14,417
Semi-Agricultural and Rural Commercial Land	4,048	889	712	1,601
Solano County				
Confined Animal Agriculture	0	0	0	0
Urban and Built-Up Land	59,157	382	52	435
Grazing Land	204,519	14,477	3,704	18,182
Farmland of Local Importance	0	0	0	0
Farmland of Potential Local Importance	0	0	0	0
Prime Farmland	135,734	47,472	0	47,472
Rural Residential Land	0	0	0	0
Farmland of Statewide Importance	7,039	4,503	0	4,503
Unique Farmland	10,525	1,173	0	1,173
Vacant or Disturbed Land	0	0	0	0
Water	53,311	12,093	796	12,889
Other Land	112,087	6,115	1,755	7,870
Nonagricultural or Natural Vegetation	0	0	0	0
Semi-Agricultural and Rural Commercial Land	0	0	0	0
Yolo County				
Confined Animal Agriculture	0	0	0	0
Urban and Built-Up Land	30,225	267	6,364	6,631

Table 3-2 (expanded)
Delta Farmland in 2008 (by County)

Farmland Type	Total Acres	Primary Acres	Secondary Acres	Legal Delta Acres
Grazing Land	157,961	11,454	40	11,493
Farmland of Local Importance	34,000	643	798	1,441
Farmland of Potential Local Importance	26,345	1,925	1,558	3,483
Prime Farmland	255,194	32,941	2,297	35,238
Rural Residential Land	0	0	0	0
Farmland of Statewide Importance	16,793	3,415	221	3,636
Unique Farmland	45,750	9,801	1,633	11,434
Vacant or Disturbed Land	0	0	0	0
Water	7,814	2,877	1,274	4,151
Other Land	79,371	11,415	3,132	14,548
Nonagricultural or Natural Vegetation	0	0	0	0
Semi-Agricultural and Rural Commercial Land	0	0	0	0

Source: FMMP, 2008

Note: All acreages rounded to nearest whole number.

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